3D PRINTING: HOW TO PRINT YOUR OWN PC PARTS

CUSTOM PC

THE BEST-SELLING MAG FOR PC HARDWARE, OVERCLOCKING, GAMING & MODDING / ISSUE 140

Graphics card megatest

15 CARDS TESTED

Gear up for the latest games

1080p TO 4K RESOLUTIONS TESTED

BENCHMARKED IN ALIEN: ISOLATION, SHADOW OF MORDOR, BATTLEFIELD 4 AND CRYSIS 3

CARDS FOR EVERY BUDGET, FROM £126 TO £600

PLUS

FIRST LOOK: PARVUM'S NEW MINI-ITX CASE

9 771740 744059 05
MAY 2015 / £5.99

OVERCLOCKERS UK
www.overclockers.co.uk

THE ONLY THING MISSING IS YOU

GAMING PCS - HARDWARE - PERIPHERALS - MONITORS - LAPTOPS

3 YEARS WARRANTY AS STANDARD · HAND PICKED COMPONENTS · BUILT & TESTED BY THE EXPERTS

TITAN ENVY M EVO

STOCK CODE: FS-052-OG

- Intel® Core™ i7 Processor 4790K @ 4.4GHz
- Phanteks Evolv (Gun Metal/Black/White)
- Asus Z97 Gryphon Motherboard
- NVIDIA GeForce GTX Graphics
- Up to 16GB DDR3 2400MHz RAM
- SSD & HDD Configurations available
- Super Flower 550W 80+ Gold Rated PSU
- Dual 120mm CPU Water Cooler

PRICES FROM **£1079.99**

TITAN KATANA DC

STOCK CODE: FS-005-OG

- Intel® Core™ i5 Processor 4690K @ 4.2GHz
- NZXT Phantom 530 (Options available)
- MSI Z97-Gaming 3 Motherboard
- AMD Radeon R Series Graphics
- Up to 16GB DDR3 2133MHz RAM
- SSD & HDD Configurations available
- Super Flower 550W 80+ Gold Rated PSU
- Prolimatech CPU Cooler

PRICES FROM **£760.99**

TITAN DAGGER

STOCK CODE: FS-080-OG

- Intel® Pentium™ Processor G3258 @ 4.2GHz
- BitFenix Neos Mid Tower (Options available)
- ASRock H81 Pro BTX H81 Motherboard
- NVIDIA GeForce GTX Graphics
- Up to 16GB DDR3 1866MHz RAM
- SSD & HDD Configurations available
- Super Flower 350W 80+ Gold Rated PSU
- Prolimatech CPU Cooler

PRICES FROM **£449.99**

Explore new ways to learn and stay connected with Intel Inside®

www.overclockers.co.uk ■ tel: 01782 444 455

Overclockers UK | Unit 5 Lymedale Cross, Newcastle-under-Lyme, Staffordshire, ST5 9BT

OVERCLOCKERS UK GAMER

Welcome

Custom PC Issue 140

Editorial
EDITOR
Ben Hardwidge
editor@custompcmag.org.uk

LABS
Matthew Lambert, Mike Jennings

MODDING EDITOR
Antony Leather

GAMES EDITOR
Rick Lane

ART EDITOR
Bill Bagnall
www.billbagnalldesign.com

PRODUCTION EDITOR
Julie Birrell

CONTRIBUTORS
Gareth Halfacree, James Gorbold, Jim Killock, Paul Goodhead, Simon Treadaway, Tracy King

PHOTOGRAPHY
Antony Leather, Gareth Halfacree, Mike Jennings

Publishing & Marketing
GROUP PUBLISHER
Paul Rayner
paul_rayner@dennis.co.uk

LICENSING MANAGER
Carlotta Serantoni
Carlotta_Serantoni@dennis.co.uk
+44 (0)20 7907 6550

LICENSING & SYNDICATION ASSISTANT
Nicole Adams
Nicole_Adams@dennis.co.uk
+44 (0)20 7907 6134

SYNDICATION SENIOR MANAGER
Anjum Dosaj
+44 (0)20 7907 6132

Commercial & Advertising
Paul Rayner
paul_rayner@dennis.co.uk

Dennis Publishing Limited
Tel: 020 7907 6000 fax 020 7907 6193

DIRECTOR OF ADVERTISING
Julian Lloyd Evans

MANAGING DIRECTOR DENNIS TECHNOLOGY
John Garewal

CEO
Ian Westwood

NEWSTRADE DIRECTOR
David Barker

FINANCE DIRECTOR
Brett Reynolds

GROUP FINANCE DIRECTOR
Ian Leggett

CHIEF EXECUTIVE
James Tye

COMPANY FOUNDER
Felix Dennis

Subscriptions
You can manage your existing subscription through **www.subsinfo.co.uk** – this should be your first port of call if you have any queries about your subscription. Email: custompc@servicehelpline.co.uk

Annual subs: UK £44.99
UK subs: 0844 844 0032

Overseas subs:
Europe £65, ROW £85
Overseas subs: +44 (,0)1795 592 906

LICENSING, REPRINTS, EPRINTS
Wright's Media
0800-051-8327 (Toll Free)

Printed by BGP

Distributed by Seymour Distribution
Tel: 020 7429 4001

OVERSEAS NEWSSTAND
Geraldine Grobler
Seymour International Ltd
+44 (0)20 7429 4066

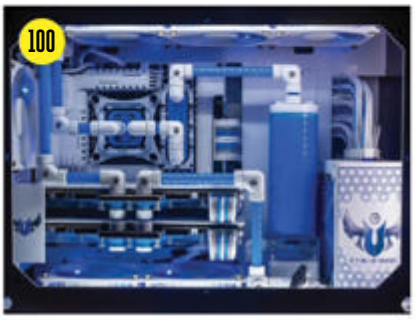
recycle
When you have finished with this magazine please recycle it.

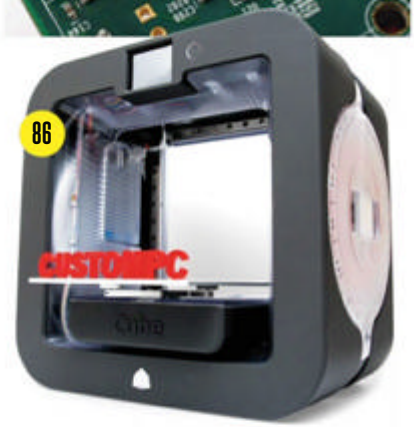
The paper used in this magazine is produced from sustainable fibre, manufactured by mills with a valid chain of custody.

Contents

Welcome to Issue 140

Highlights





Regulars

Cover guide

Reviewed this month

29 PRODUCTS REVIEWED

Hardware

CPU COOLER
17 Corsair Hydro Series H110i GT

MOTHERBOARD
18 MSI Z97i Gaming ACK

CASES
20 Parvum Systems X1.0
24 NZXT H440 Special Edition

GAMING LAPTOP
26 Dino PC Phoenix 17.3in GTX 980M SLI Gaming Laptop

GPU COOLER
30 Arctic Accelero S3

GAMING HEADSET
32 SteelSeries Siberia V3

Custom kit

38 Patriot FUEL iON Galaxy S4 Case & Stand
38 Patriot FUEL iON Car Mount
38 Death Star Ice Mould
39 Divoom Voombox Ongo
39 PNY LM3000
39 QDOS Portland

Graphics card Labs test

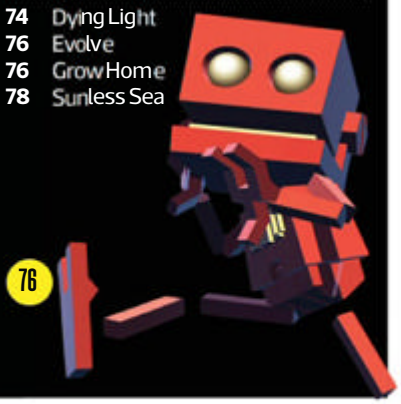
42 AMD Radeon R9 270X
42 AMD Radeon R9 280
43 AMD Radeon R9 285
46 Nvidia GeForce GTX 960
48 AMD Radeon R9 280X
48 AMD Radeon R9 290
49 Nvidia GeForce GTX 970
51 AMD Radeon R9 290X
52 Nvidia GeForce GTX 980
53 AMD Radeon R9 295X2

Mid-range gaming PCs

58 Box Cube Blizzard
58 Cyberpower Infinity Achilles XT

Games

74 Dying Light
76 Evolve
76 Grow Home
78 Sunless Sea



Cyberpower recommends Windows.

CYBERPOWER

Create the PC of Your Dreams

To Custom Build
Your Ideal Desktop
or Laptop, Visit :

www.cyberpowersystem.co.uk

0844 371 2727

Infinity Xtreme

Extreme Performance Gaming Station

Windows 8.1

MSI® X99S SLI PLUS Mainboard
16GB DDR4 2133Mhz Memory
240GB Kingston V300 SSD
2TB 7200rpm SATA III 6.0Gb/s 64MB HDD
4GB Nvidia® GTX 970 Video Card
NZXT H440 Gaming Case
Corsair H55 Cooling System
LCD monitor is not included but optional

Intel® Core™ i7 Processor	
5960X	£ 2119
5930K	£ 1669
5820K	£ 1479

From £ **1479** Inc VAT and Del

DVD 24X±RW · HD 7.1 · CoolerMaster® · CoolerMaster® · 12-in-1 Card Reader · CoolerMaster B600 Power Supply · Free Xtreme Overclocking

Infinity X5

A Media Dream for Photo/Video Editing
4th Generation Intel® Core™ Processor

Windows 8.1

Gigabyte® Z97-HD 3 with SATA III, USB 3
8GB Kingston HyperX Fury
1866Mhz DDR3 Memory
2TB 7200rpm SATA III 6.0Gb/s 64MB HDD
2GB Nvidia® GTX 960 Graphic Card
NZXT Phantom 410 Mid Tower White
Corsair H55 Cooling System
LCD monitor is not included but optional

Intel® Core™ i7 Processor	
4790K 3.5Ghz	£ 979
4790 3.4Ghz	£ 945
Intel® Core™ i5 Processor	
4690K 3.4Ghz	£ 875
4690 3.4Ghz	£ 859
4590 3.2Ghz	£ 839

From £ **839** Inc VAT and Del

DVD 24X±RW · HD 7.1 · CoolerMaster® · CoolerMaster® · 12-in-1 Card Reader · Coolermaster 500 W Power Supply

Unleash The Power

- Free UK delivery*
- All desktops come with 3 year warranty**
- Flexible finance available and secure online payment

*UK mainland only, see our website for detail
**See our website for detail

Infinity Xtreme Pro

Extreme CPU & VGA Water Cooling Gaming Monster
Intel® Core™ Processor i7-5960X

Windows 8.1

ASUS® X99-A Mainboard
16GB 2133mHz DDR4 Memory
480GB Kingston® V300 SSD
2TB SATA III 6.0Gb/s 64MB HDD
4GB Nvidia® GTX 980 Graphic Card
16X Pioneer BluRay BDR-209DBK Writer Black
CoolerMaster Staker 935 Gaming Case
Cyberpower Advance Water Cooling system Medium Size
LCD monitor is not included but optional

Intel® Core™ i7 Processor Extreme Edition

5960X 3.00Ghz 20MB	£ 2599
5930K 3.50Ghz 15MB	£ 2149
5820K 3.30Ghz 15MB	£ 1959

From £1959 Inc VAT and Del

Blu Ray 16X Writer | HD 7.1 | CoolerMaster® | CoolerMaster® | 12-in-1 Card Reader | CoolerMaster B700W Power Supply | Free Xtreme Overdocking

intel® inside™ CORE™ i7

Infinity X3

Great Value for Money Home PC with Water Cooling
Intel® Core™ i5 Processor

Windows 8.1

ASUS® H81M-D Plus Mainboard
8GB Kingston HyperX Fury 1866Mhz DDR3 Memory
2TB 7200rpm SATA III 6.0Gb/s 64MB HDD
2GB NVIDIA® GTX 750 video card
CoolerMaster HAF 912 Gaming Case
Corsair H55 Cooling System
LCD monitor is not included but optional

Intel® Core™ i7 Processor

4790K 3.6Ghz	£ 809
4790 3.5Ghz	£ 775

Intel® Core™ i5 Processor

4690K 3.4Ghz	£ 705
4690 3.4Ghz	£ 689
4590 3.2Ghz	£ 669

Intel® Core™ i3 Processor

4360 3.6Ghz	£ 625
4350 3.5Ghz	£ 625
4160 3.4Ghz	£ 589

From £589 Inc VAT and Del

DVD 24X±RW | HD 7.1 | CoolerMaster® | CoolerMaster® | 12-in-1 Card Reader | 450 W Power Supply

Infinity X7

High Performance All-Rounder
Intel® 4th Generation Core™ Processor

Windows 8 .1

ASUS® Z97-P Mainboard
16GB 1866Mhz DDR3 Memory
120GB Kingston V300 SSD
2TB 7200rpm SATA III
4GB Nvidia® GTX 970 Video Card
CoolerMaster Cosmos SE Full-Tower Gaming Case
Corsair H55 Cooling System
LCD monitor is not included but optional

Intel® Core™ i7 Processor Extreme Edition

4790K 3.6Ghz	£ 1285
4790 3.5Ghz	£ 1249

From £1249 Inc VAT and Del

DVD 24X±RW | HD 7.1 | CoolerMaster® | CoolerMaster® | 12-in-1 Card Reader | CoolerMaster B600 Power Supply | Free Xtreme Overdocking

FANGBOOK III HX6-100

Gaming Laptop with 4th Generation
Intel® Core™ i7-4940MX Extreme Mobile Processor
Intel® HM87 Chipset
WiFi Link 802.11 A/B/G/N Wi-Fi + Bluetooth Combo

Windows 8.1

8GB DDR3 1600 SODIMM Memory
1TB 5400RPM SATA HDD
15.6" HD 1920 x 1080 Display
2GB Built-in Nvidia® GeForce® GTX 860M Video Card
Built-in LAN & Wireless N Network Card
Built-in 720 Pixels HD Webcam

Intel® Core™ i7 Processor Extreme Edition

4940MX	£ 1455
4910MQ	£ 1045
4810MQ	£ 915
4710MQ	£ 799

From £799 Inc VAT and Del

1x HDMI | 2x USB 3.0 | 3 hr | 2.58 kgw | DVD 8X±RW | Built-in Wireless

FANGBOOK III HX7-200

Gaming Laptop with 4th Generation
Intel® Core™ i7-4940MX Extreme Mobile Processor
Intel® HM87 Chipset
Intel® Dual Band Wireless- AC 7260HMW
802.11AC, Wi-Fi + BT 4.0 combo

Windows 8 .1

16GB DDR3 1600 SODIMM Memory
120GB Kingston V300 MLC SSD
1TB 5400RPM SATA HDD
17.3" Full HD 1920 x 1080 Display
6GB Built-in Nvidia® GeForce® GTX 970M Video Card
Built-in 720P HD Webcam

Intel® Core™ i7 Processor Extreme Edition

4940MX	£ 1949
4910MQ	£ 1489
4810MQ	£ 1315
4710MQ	£ 1195

From £1195 Inc VAT and Del

1x HDMI | 3 hr | 3.04 kgw | DVD 8X±RW | Built-in Wireless

BEN HARDWIDGE / FROM THE EDITOR

GRAPHICS EQUALISER

Thanks to AMD's price cuts, there's never been a better time to buy a high-spec GPU, says Ben Hardwidge

As I write this column, there's a bizarrely heated debate on Twitter and Facebook about the colour of a dress in a badly taken, overexposed photo. Some people say the dress is blue and black; others say it's gold and white. And everyone who sees the dress as anything other than the colour scheme parsed by your brain is clearly a heretic who needs to be burned, along with people who can make Magic Eye pictures work. To me, it looks blue and black, and a quick check in Photoshop confirmed it was indeed blue and black. There's nothing quite like hard mathematics to challenge your perception, and that's particularly true with our graphics card Labs this month.

As always, we determined the scores scientifically using a complicated Excel spreadsheet that an accountant helped us to put together. We feed the frame rates from each test into the spreadsheet, and it awards points for minimum frame rates that hit our 25fps, 30fps and 60fps targets, as it's the minimum that you notice when your game slows down, rather than the average. The spreadsheet is intended to reward cards that offer a real-world benefit, so you know that upgrading to one card will make a game playable that isn't possible on another card. After all, if one card drops down to 9fps, and one drops down to 6fps, the 9fps card isn't better in a useful way – both results are unplayable.

Once all the scores are in, the spreadsheet then calculates value for money, based on the frame rate targets hit for the cheapest price we can find for that GPU online. For the first time, we've also incorporated efficiency into the final score this time around, as noise and power consumption are increasingly becoming a bigger deal. It only makes up 10 per cent of the score, so performance and value are still the key factors, but we wanted a way to reward GPUs that are power-efficient, as well as offering a good bang per buck.

> The Radeon R9 280 is now so cheap that the R9 270X is effectively redundant

But it's bang per buck that's the most important factor. The all-important question is which card offers the best balance of minimum frame rates for the money, and AMD's recent aggressive price cuts have completely obliterated the GPU landscape. Just last month, we had the Radeon R9 270X listed as our affordable 1080p GPU of choice, but the Radeon R9 280 is now so cheap that the R9 270X is effectively redundant. It isn't that the R9 270X is now a bad GPU (it will still handle games fine at 1080p), it's just the bang per buck ratio is now so skewed by the cheaper R9 280 that its score takes a hammering.

Perhaps more interestingly, though, Nvidia's GeForce GTX 960, and even the GTX 970, have also been hit hard by these price cuts, despite efficiency now being a part of our scoring system. The GTX 970 is still a great, power-efficient GPU, but it costs more than AMD's Radeon R9 290, and it's only a little cheaper than AMD's single-GPU flagship, the R9 290X. These AMD cards might be comparatively old, and power-hungry, but at their current prices, they're veritable bargains.

We didn't quite believe the scores when we saw them, but I assure you that they're correct. The GTX 970 is a new and efficient GPU, and it blew us away when we first saw it, but AMD dropping the price of its fastest GPUs has seriously hammered its bang per buck ratio.

Whether this situation is sustainable remains to be seen, but at the moment, thanks to AMD, there's never been a better time to buy a top-spec GPU. CPC

Ben Hardwidge is the editor of Custom PC. He likes PCs, heavy metal, real ale and Warhammer 40,000. editor@custompcmag.org.uk @mandogfish

FROM THE DIRECTOR OF **THE DARK KNIGHT TRILOGY** AND **INCEPTION**

INTERSTELLAR

OWN IT ON DIGITAL HD FROM MARCH 17
OWN IT ON BLU-RAY™ AND DVD FROM MARCH 30

LEGENDARY SYNCOPY

Synology®

Store and Stream movies with Synology NAS

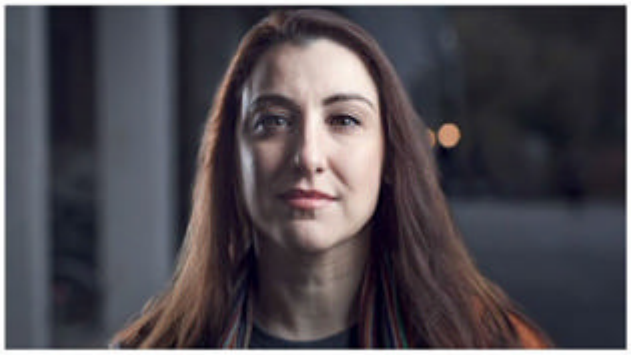
For details on where to buy, please visit www.synology.com

DS214play DS415play

iOS dlna AirPlay

To celebrate the release of the latest Christopher Nolan epic, Interstellar (on Digital HD, Blu-ray™ and DVD), Synology is giving you the chance to win great prizes so please join us at The Gadget Show Live (8-12 April) or visit our Facebook page

The Gadget Show LIVE
7-12 APRIL 2015 • NEC BIRMINGHAM



TRACY KING / SCEPTICAL ANALYSIS

STOCK AND BULL

Is stock market trading via a 'fun' app really just superstitious thinking seeping into technology, asks Tracy King

Orlando stared at the screen. His stocks were performing well, but he wasn't in the lead. His competitors, brokers and wealth managers from several of Britain's finest firms were making more money than him and, with only three months to go, Orlando had to act fast, and act smart. He picked up his mouse and took a deep breath. Three months later, his risks paid off. Orlando was declared the winner of The Observer's Portfolio challenge, turning a 4 per cent profit on an initial investment of £5,000, double the profit of the professionals. Which is odd, because Orlando is a cat.

The Observer's 2012 experiment wasn't remotely scientific or even particularly fair, but it illustrates a common question with stock market trading: can you perform just as well with random selections as carefully studied stock picks? The Random Walk Theory posits that stocks and shares are random, that no pattern emerges with study, so you can't predict the market based on the past.

In casinos, blackjack tables display a running tally of which numbers have come up. Gamblers use it to try to predict which number is more likely, or perhaps 'due', to come up next. This is, of course, completely irrational. Leaving aside the small margin for dealer manipulation, previous numbers have absolutely no bearing on future numbers. You know all this, I expect. People who understand probability are agog at people who buy lottery tickets. And yet the National Lottery presenter will tell viewers how frequently a particular number has been drawn, as though somehow the balls themselves are imbued with a 'me next!' will and memory of past performance.

Whether or not stock market trading is an exact science remains up for debate, the subject of many scientific papers and even a Nobel prize, and certainly all those analysts and financial managers are doing something. I'm not particularly concerned about what that something is, as I don't have a broker and don't play the market (although I do have a cat). What concerns me is whether or not superstitious thinking is seeping into our technology. In January, I read an article praising the accessibility and fun of market trading apps such as Bux, which promises 'the excitement of the stock exchange in your back pocket', which could easily be the strapline for a casino app.

> I put 150 'funBux' on Netflix, because I love Netflix, and the same on Tesla Motors, because they're cool

At the start, Bux gives you pretend money called 'funBux', so you can't just wade in and throw £500 of real cash on Amazon. That partly reassured me, and partly screamed 'you're dabbling in a serious world, and this colourful jaunty app is possibly going to bankrupt you'. I installed it anyway, and immediately put 150 'funBux' on Netflix, because I love Netflix, and the same amount on Tesla Motors, because they're cool.

I sneered at the opportunity to pretend-invest in HSBC or Yahoo, and then deleted the app because it was clear my decisions were based on personal bias and absolutely no data whatsoever. Had my funBux stocks performed well, no doubt I would have experienced both pleasure and some post-hoc rationalisation along the 'I totally know what I'm doing' lines and maybe progressed to investing real money.

In the end, amateur trading via technology seems to be akin to casino gambling, and it's arguably no more or less scientific.

Although stock prices are influenced by data, by the time the price has changed, you're too late to take advantage of it, so it's best left to the experts, or possibly the cat. CPC

Gamer and science enthusiast Tracy King dissects the evidence and statistics behind popular media stories surrounding tech and gaming @tkingdoll

VENOM

BlackBook 15

Now Slimmer, Lighter & More Powerful

venomcomputers.com.au

Letters

Please send us your feedback and correspondence to letters@custompcmag.org.uk

RAID to measure

I just want to say I love the magazine. I've been collecting and subscribing for at least ten years now! I need some advice on storage and backups. I'm a photographer, but I can't get faster than a 1-2Mb/sec upload where I live, so online backup isn't viable. I would like to build a new drive to hold backups, but I'm not sure which route to take. I plan to go with a NAS system, but what RAID system should I use, if any? I really want to get better speeds and take advantage of my Gigabit Ethernet connection. Would hybrid drives make a big difference over normal drives? Any help would be greatly appreciated!

JAMES LAWSON

Ben: I feel your pain, James, as I've just moved away from a flat where I could only get a 1Mb/sec upload connection, and it was a royal pain. The first thing to say is that there's little point in putting a hybrid hard drive in a NAS box, as in most cases, the network speed will be the limiting factor over the speed of the hard drive. I would buy a NAS box with space for two hard drives (Synology boxes are great for software features and ease of setup, although they can also be comparatively expensive), and then install two identical drives in RAID 1 (mirrored) configuration.

You'll only be able to use the capacity of one of the drives, but the second drive will mirror it exactly, so if one hard drive goes down, you can still keep your system going with the second one while you get it replaced – it minimises downtime. On top of that, I would also plug a USB external hard drive into the NAS box, and set up a daily backup to it. You then have every base covered for your data, giving you both a backup and a failsafe if one of your drives breaks.

With a dual-bay NAS you can set up two drives in a mirrored array, creating a failsafe to minimise downtime if one drive breaks

Pitter platter

I was at the early stages of ordering a new hard drive for my PC, and, as one would expect, I consulted the your Elite list first. It recommends the 2TB Seagate Barracuda ST2000DM001, and indeed it has done well for quite some time. I even faintly recall the drives under test, and the major reason for the impressive read/write figures was down to the fact that the drive only had two 1TB platters, making access really speedy. So far, so good.

However, this drive ships in two configurations. One is blindingly fast as tested, with two 1TB platters, but the other is nowhere near as fast, with three 666GB platters. Both drives ship under the same model number, and there's no guarantee that your dealer will know which type their supplying.

There is a very obscure letter change in one of the product codes carried on the drive case, and the 'good' drive also has a deeper indent on the underside – although it will be hard to tell the difference without the two drives sitting side by side.

I know you publish your recommendations in good faith, and will be as concerned as me to discover that two vastly different performing drives have the same model number. Could I advise readers to be extra-careful when ordering this drive, and be prepared to send an RMA if the unit supplied is incorrect?

I also have one final question regarding hard drives in general. My boot drive will now always be a solid state drive, but some people say I wouldn't need a secondary drive as fast as the aforementioned twin-platter Seagate drive. Is there any truth in that?

RICK BILLSON

Ben: Thank you for bringing this to our attention, Rick – a quick Google shows several people reporting the same issue, and it's disappointing to hear that Seagate may be shipping triple-platter drives with the same model number as the fast two-platter drives – I'll try to look into this further to find out if there's a way to guarantee you'll get a two-platter drive.

To answer your question though – yes, it's less important to have solid state storage for general data files. In an ideal world, everything would be solid state, but even today, solid state storage

Our original review sample of Seagate's Barracuda ST2000DM001 had two 1TB platters, rather than three 666GB platters

> While it won't win any modding competitions on its own, I'm really chuffed with what I've achieved!

is very expensive in terms of cost per gigabyte compared with a hard drive, so most people compromise.

Where you notice the difference with solid state storage is with boot times, app loading times and the responsiveness of the operating system – for everything else, a hard drive usually does the job fine.

From my personal perspective, the speed of a hard drive is largely irrelevant now, as I have a decent-sized solid state system drive, and store all my data on a NAS drive, and the network connection is the limiting factor there, even if you're using a triple-platter hard drive. However, I also completely understand why people would feel short-changed by receiving a three-platter drive instead of a two-platter model.

DAC to the future

I was interested to read your comments about Cambridge External DACs, not knowing much about audio. I'm only interested in good-quality stereo audio, so this might be upgrade for me at a later date. I was wondering if, when you review sound cards next, maybe you could include external DACs too?

DAVE

Ben: If we ever do a sound card Labs again then we'll be sure to include some external DACs, yes. If high-quality stereo sound quality is your priority then that's definitely the option I'd choose.

Gift of the mods

After subscribing to Custom PC mag for many years, I finally felt inspired to actually get up and mod. When I bought my Cooler Master HAF-X case, I wasn't bothered about it not having a 3.5in front-facing drive bay, as I was never going to use a floppy drive again.

However, when I decided to get an internal card reader, it was in a 3.5in drive size. The HAF-X has metal- grilled bay blankers, which look really cool, and I didn't want to get a plain plastic adaptor, so I decided to use the one I would have replaced with the drive and mod it.

Firstly, I got out my Ryobi multi-drill (other Dremel-type drills are available!) and started to cut a slot with the drill. Sparks flew everywhere, and I was a little terrified, so I then got out my side cutters instead.

I cut out a hole in the middle, and the excess was bent around a 4mm piece of Perspex to create a slot. I then fixed it to the reader using black Sugru, which also hides the metallic gray sides poking out.

While it won't win any modding competitions on its own, I'm really chuffed with what I've achieved! I'm also really chuffed about seeing my 600,000 Folding@home milestone in the April issue.

CATFLAPS

Ben: This what it's all about! Well done for giving it a go – I find modding even small parts is really satisfying. You get the exact computer part you want, you cut down on waste and you get all the fun of playing with rotary drills too (they're not that terrifying when you've used them a fair bit). If any other readers want to send in photos and details of small mods they've done, we'd love to see them. CPC

WHEN'S THE NEXT MAG COMING OUT?

Issue 141 of Custom PC will be on sale on Thursday, 16 April, with subscribers receiving it a few days beforehand. Visit http://tinyurl.com/CPCDates to see the release dates for the rest of the year.

Twitter highlights

Follow us on Twitter at @CustomPCmag

RiponLaptops Excellent guide to ED! A must have game for any PC Gamer!

limivorous I thought HDD caddies were meant to be ridged. How on earth did you manage to bend one on the front of the subscribers issue?

Antony: I would say that's a good spot Craig, but it's actually pretty obvious, so I have no idea how I missed it. I was probably focusing too much on getting the right angle for the photo – anyway, consider my wrist slapped!

kajun_cheng New issue of @CustomPCMag arrived. About to read it with my #BeverageApproved mug!

DrSDClarke Can't wait to get my hands on one of those Falcon Core 51s... £200! Bargain :)

Ben: Yes, thank you to the many of you who pointed out the price of the Falcon PC in Issue 139, p62. This was actually a bigger cock-up on our part than it initially looks, as we've explained on p14.

Send your feedback and correspondence to letters@custompcmag.org.uk

Incoming

We take a look at the latest newly announced products

BitFenix introduces water-cooling cases

BitFenix has previously wowed us with its Prodigy cases, enabling you to build a decent-spec mini-ITX rig, and its latest Aegis chassis is aimed at people wanting to build a water-cooled micro-ATX machine. The Aegis has room for either two 280mm radiators, or a 360mm and 240mm radiator combination. There are mounts for up to eight 120mm fans (or five 140mm spinners), and the case also sports the very fancy (and customisable) 2.8in TFT ICON display that we first saw with the BitFenix Pandora. The Aegis is also available in several colours, including black, blue, red, white and yellow, and can be pre-ordered for £80 inc VAT from **www.overclockers.co.uk** now.

New Fractal fans

Acclaimed case maker Fractal Design has just announced a load of new fans, aimed at a variety of PC cooling situations. First off is the Dynamic Series range, which comes in 120 and 140mm flavours, and are available in an all-black or black and white finish (pictured). The Dynamic fans feature hydraulic bearings and what Fractal calls 'aerodynamically shaped thin stator struts', which the company says mimic the design often found on aeroplane wings to reduce turbulence. The 120 and 140mm models will be priced at £8.99 and £9.99 inc VAT respectively.

Meanwhile, the Silent Series R3 fans are designed to offer affordable, quiet and effective cooling, and are available in all-black and black and white finishes. There are more sizes in this range, though, with 40, 50, 50, 80, 92, 120 and 140mm models, starting at £4.99 and going up to £7.99 inc VAT.

Steam machines are go

After a mysterious silence about Steam machines and controllers since last year, Valve has announced plans to show off a bunch of new Steam devices at the Games Developers Conference (GDC) in San Francisco this year. The company says the demo will encompass steam machines with the final Steam controller, as well as 'new living room devices and a previously-unannounced Steam VR system'.

CORRECTION

Falcon Core 51 Pro SLI Gaming PC

In our review of the Falcon Core 51 Pro SLI Gaming PC (see Issue 139, p62), we mistakenly printed the price of the machine as £2,000 (or £2,00 as some of you spotted). The price is, in fact, £1,899 inc VAT – we got it wrong, and sincerely apologise to Falcon for the error, which affected the final score awarded to the machine. Falcon is also offering an upgrade to a two-year collect and return warranty for an extra £50, matching the warranty on the Overclockers Ultimate Finesse Blackhole featured in the same head to head section. You can order the Falcon Core 51 Pro SLI Gaming PC now from **http://tinyurl.com/FalconCPC**

CUSTOM PC APPROVED

SPEED	HARDWARE	OVERALL SCORE
24/25	23/25	88%
DESIGN	VALUE	
20/25	21/25	

Silencio Series Chassis

Silencio 652S - Full Tower | Silencio 452 - Mid Tower | Silencio 352 - Mini Tower

Designed for supremely silent computing with noise dampening materials and whisper quiet fans, but without compromising cooling performance. Silencio Series cases feature elegant, minimalistic aesthetics to complement the silent design.

CPC & bit awards 2012 WINNER BEST CASE MANUFACTURER

CPC & bit awards 2013 WINNER BEST CASE MANUFACTURER

CUSTOM PC AWARDS 2014 WINNER BEST CASE MANUFACTURER

Silencio FP 120 PWM Fan

the perfect companion to your silent build

coolermaster.co.uk

ebuyer.com technology delivered

box.co.uk

SCAN computers

amazon

OVERCLOCKERS UK

Reviews

Our in-depth analysis of the latest PC hardware

Reviewed this month

ELITE
NEW ENTRY
P62

CPU COOLER

Corsair Hydro Series H110i GT / £101 inc VAT

SUPPLIER www.overclockers.co.uk / **MODEL NUMBER** CW-9060021-WW

LGA2011 LGA115x

Corsair's new Hydro Series H110i GT cooler is an absolute monster, using a half-height double 140mm-fan radiator and two Corsair SP140L fans that can ramp up their speed to 2,100rpm.

If you have a particularly large case that can house the entire cooler with fans internally, you'll encounter no issues. Otherwise, though, you'll need a twin 140mm fan mount inside your chassis – ideally in the roof – and a large enough gap at one end to allow the tubing to pass into your case, along with a decent-sized gap between your motherboard and case at the top.

Screws are included to mount the H110i GT with the radiator or fans first to your case, with the optimal setup being a roof location with the fans beneath, blowing air through the radiator and out of the case. The pump section looks a little different to previous i-series Corsair coolers, but the simple-to-install mounting mechanism is basically the same, with a backplate, mounting plate, pins and thumbscrews.

> You'll need a twin 140mm fan mount inside your chassis – ideally in the roof

Corsair has also enhanced the aesthetics, with an RGB-illuminated pump section, inset strips on the radiator showing the Corsair logo and tubes covered in thick braid; it definitely looks less generic than its predecessors. A single SATA power connector powers the pump and the two fans. Being an i-series cooler, the H110i GT also works with Corsair's Link control software by connecting the pump section to a motherboard USB header.

The fan and pump speed are adjustable, and the level of control and monitoring is excellent. You can tie the fan speed to several inputs, including the CPU or H110i GT's internal temperature, and monitor temperatures over time and control the pump lighting.

In our LGA1150 system, the H110i GT matched the H105 with a delta T of 47°C, and it was 7°C cooler than the H75 too. Raijintek's Triton cooler cooled a little better, but it was noisier at its maximum fan speed setting, although the H110i GT is also noisy at maximum speed. Reducing the H110i GT's fans and pump to minimum speed saw it operate at whisper-quiet levels, but the delta T only rose by 5°C.

Our LGA2011 system has recently been through a revamp, so we only have comparative results for Corsair's H75 and H105 coolers at the present time.

Even so, the HydroH110i GT beat the H105 by 1°C and was 9°C cooler than the H75. On low fan speed settings, it still managed to tame our overclocked Core i7 3960X, with the delta T rising by just 3°C.

/SPECIFICATIONS

Compatibility Intel: LGA2011, LGA2011-v3, LGA115x, LGA1366, LGA775; AMD: Socket AM3+, AM3, AM2+, AM2, FM2+, FM2, FM1

Radiator size with fans (mm) 322 x 140 x 52 (W x D x H)

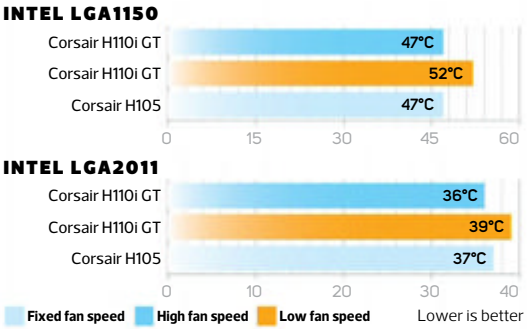
Fans 2 x 140mm

Stated noise Up to 43dB(A)

Conclusion

The huge H110i GT offers great looks, customisable lighting and superb cooling. In fact, in LGA2011 systems, only a custom water-cooling kit would offer better cooling. You'll need a large space in your case to mount the radiator, and it's overkill for most LGA1150 systems, but it's very effective cooler for LGA2011 systems.

ANTONY LEATHER



LGA115x

COOLING	DESIGN	VALUE	OVERALL SCORE
39/40	25/30	25/30	89%

LGA2011

COOLING	DESIGN	VALUE	OVERALL SCORE
39/40	25/30	27/30	91%

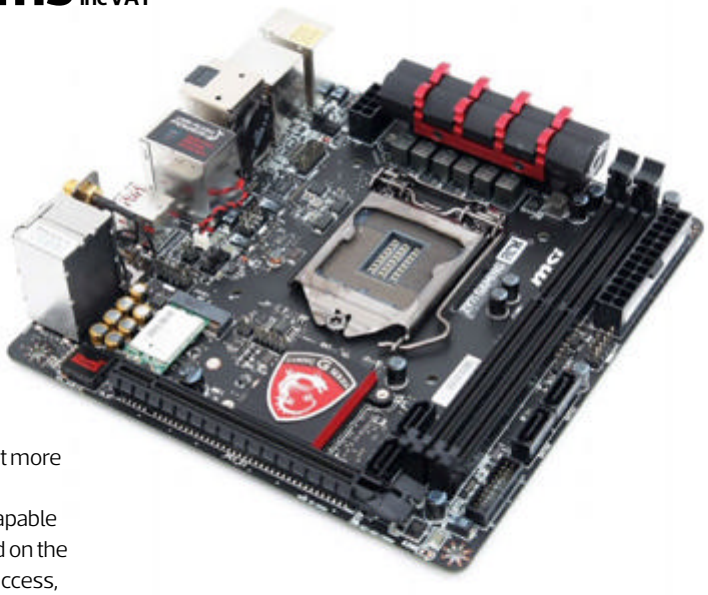
VERDICT

Monstrous cooling and comparatively modest noise levels. A great cooler for LGA2011 systems.

LGA1150 MOTHERBOARD

MSI Z97i Gaming ACK / £115 inc VAT

SUPPLIER www.scan.co.uk



We first took a look at MSI's Z97I Gaming AC back in Issue 131, where it picked up an Approved award despite some reservations over its layout. It still boasted an excellent EFI, a number of features and a reasonable price tag of £109, so while it could be tricky to cable-tidy a system using one, it still offered fierce competition. Thankfully, MSI has now seen fit to refresh it with a new design, launching the Z97i Gaming ACK to replace it.

The ACK retails for a little more at £115, but you get more for your cash. The previous model lacked both SATA Express and M.2, but the ACK now sports an SSD-capable M.2 port. Like Asus' Z97i-Plus, the M.2 port is located on the rear of the PCB, which potentially makes it tricky to access, although most people aren't in the habit of removing their SSDs or hard disks on a regular basis. Sadly, it's limited to SSDs up to 60mm in length, though, which limits your options. There's also a second smaller M.2 port on the top side of the PCB, which is occupied by a Killer 1525 802.11ac Wi-Fi adaptor that's connected to two antennas on the rear I/O panel.

> It's almost unrecognisable compared to its predecessor

The rest of the specification hasn't changed much. There are still four SATA 6Gbps ports, Realtek ALC1150-based 8-channel audio, with an isolated PCB and the usual two DIMM slots that support up to 16GB of RAM. What has changed, though, is the layout. In fact, apart from a similar colour scheme, the Z97i Gaming ACK is almost unrecognisable compared to its predecessor. The CPU socket has been moved up a couple of centimetres the PCB to give more clearance between it and the 16x PCI-E slot. Meanwhile, the PCH chipset is now located at the bottom of the PCB, while the VRM heatsink sits at the top, instead of behind the rear I/O panel.

The most useful changes, though, come from the new port layout. The SATA 6Gbps ports, for example, have moved from their awkward spot at the top of the PCB, with two now located along the right edge and the other two behind the DIMM slots. The 24-pin ATX connector is better placed too, and sits on the right edge next to the DIMM slots, as does the USB 3 header. The best news is that the 8-pin EPS connector is roughly where you'd find it on other motherboards now too, instead of stuck annoyingly behind the rear I/O ports, while the front panel connectors now sit much closer to the likely location of the front of your case. Mini-ITX cases vary considerably in their internal layout, of course, but these improvements should make tidying your cables and building your PC much easier.

Overclocking tools are pretty sparse though; there's just a clear-CMOS button located among the rear I/O ports – no power or reset buttons. However, you'll have to fork out a shedload more cash for Asus' Maximus VII Impact to get more of these features. MSI does include a few extra features elsewhere, though, such as what it claims to be the world's first combination of Killer LAN and Wi-Fi. You can use the Wi-Fi adaptor to connect separately to the Internet for mundane tasks such as video streaming, while leaving the Ethernet port free for low-latency gaming. It's a niche feature but potentially useful at LAN parties. There's also a dedicated USB port for external audio DACs that offers a stable 5V power supply.

Performance

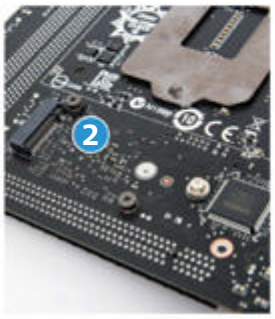
Out of the box, the Z97i Gaming ACK didn't perform that well, partly because of its mediocre use of the CPU's Turbo Boost feature, where it was often 200MHz lower under load than other boards we've tested. MSI includes an option for enhancing the Turbo Mode, though, which improved performance considerably – we've listed the default results in the graphs. Overall, its score of 2,394 was less than 100 points short of the Maximus VII Impact and less than 50 points shy of the Asus Z97i-Plus. There was also a 1fps difference in the minimum frame rate in Skyrim.

In terms of overclocking, our target of 4.8GHz was a little trickier than usual to hit, mainly due to our CPU getting quite toasty as we approached our goal. A vcore of 1.28V was needed for a stable 4.8GHz clock – higher than its predecessor, although the CPU was just inches away from throttling so this figure is to be considered a maximum overclock and not a frequency to use every day. That said, MSI has really nailed its EFIs recently, and the Z97i Gaming ACK's EFI is no exception. It's less cluttered and easier to use than Gigabyte EFIs we've seen recently, and while there are fewer features than your average Asus ROG board, it's just as well laid out.

/SPECIFICATIONS

Chipset Intel Z97
CPU socket Intel LGA1150
Memory support 2 slots: max 16GB DDR3 (up to 3200MHz)
Expansion slots One 16x PCI-E 3
Sound Realtek ALC1150 8-channel
Networking Killer E2205 Gigabit LAN, Killer 1525 802.11ac WiFi + Bluetooth V4.1
Overclocking Base clock 90–300MHz, CPU Multiplier 8–80x; max voltages, CPU 2.1V, RAM 2.7V
Ports 4 x SATA 6Gbps (Z99), 6 x USB 2, 6 x USB 3, 1 x LAN, 3 x surround audio out, line in, mic, optical S/PDIF out, 2 x HDMI, 1 x DisplayPort, 2 x Wi-Fi antenna ports
Dimensions (mm) 170 x 170

HOW WE TEST
PAGE 34



1. The improved layout means there are now SATA ports lined up on the right edge of the PCB
2. There's an M.2 port on the rear of the PCB, although it only takes 60mm-long SSDs
3. A second smaller M.2 port is occupied by a Killer 1525 802.11ac Wi-Fi adaptor

Performance was more competitive once overclocked, although the overall score of 2,854 was way short of Asus' Maximus VII Impact and the ACK's predecessor. However, it was within striking distance of the Z97i-Plus. It was slightly faster than the latter in Skyrim too, although once again, the Impact was on top. There were no gremlins when it came to the SATA 6Gbps speed tests, with read and write speeds of 546MB/sec and 522MB/sec respectively, although the M.2 speed was too small for our test SSD. Power consumption results were polarising; at idle, it offered the lowest numbers we've seen, but was a little on the high side when overclocked, drawing 209W compared to its predecessors' 167W, mainly because of the higher voltage needed.

Conclusion

MSI's Z97i Gaming ACK has an improved layout, loads of features, a great EFI and a reasonable price.

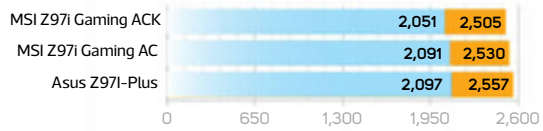
However, the ACK also gets hot when overclocked and its M.2 port is comparatively short. Meanwhile, Asus' similar Z97i-Plus also has a great layout and EFI, and costs a little less money too, although the MSI board has better looks.

The Asus remains the slightly better buy at £106 inc VAT from **www.overclockers.co.uk**, but the MSI is still a fine motherboard for £9 more if you prefer its looks.

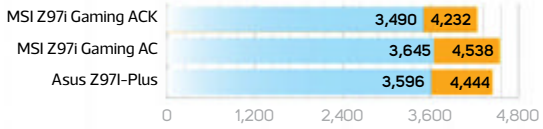
ANTONY LEATHER

CPC MEDIA REALBENCH 2007

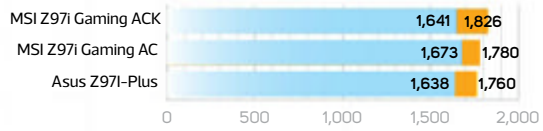
GIMP IMAGE EDITING



HANDBRAKE H.264 VIDEO ENCODING



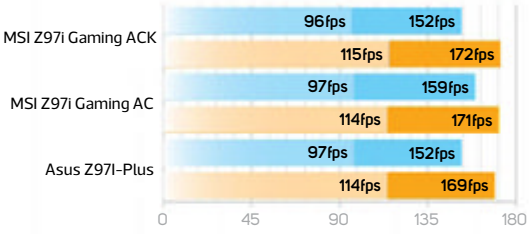
HEAVY MULTI-TASKING



OVERALL

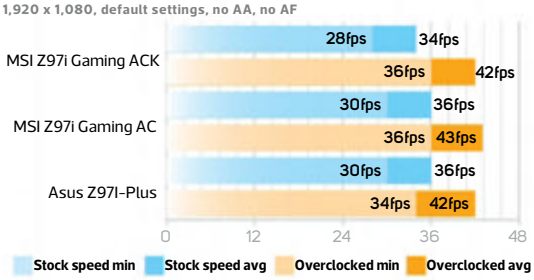
THE ELDER SCROLLS V: SKYRIM

1,920 x 1,080, 16x AF, 0x AA



SHOGUN 2: TOTAL WAR CPU TEST

1,920 x 1,080, default settings, no AA, no AF



SPEED 35/40 | FEATURES 24/30

VALUE 26/30

OVERALL SCORE 85%

VERDICT

A vastly improved layout over the Gaming AC, with good looks and a decent EFI. However, it gets hot when overclocked and the similar Asus Z97 I-Plus is cheaper.

/TEST KIT

3.5GHz Intel Core i7-4770K, 16GB Corsair Vengeance Pro DDR3 1,866MHz DDR3 memory, 128GB OCZ Vector 150 SSD, Nvidia GeForce GTX 780 3GB, Corsair Pro Series Gold HX750 PSU, Windows 7 64-bit

MINI-ITX CASE

Parvum Systems X1.0 / £100 inc VAT

SUPPLIER www.overclockers.co.uk / MODEL NUMBER PARV-X1CR

We're huge fans of Parvum's micro-ATX S2.0. Parvum has been working its acrylic magic in other ways recently too, and we've seen ATX and mini-ITX prototypes on various forums over the last few months. The company's second case is finally here and, at £100, the X1.0 isn't cheap for a mini-ITX case. In fact we can only think of one or two examples that cost more.

Also, as with the S2.0, the case arrives flat-packed, so you have to build it yourself, although in our opinion, this adds to the experience of building your PC. That said, you'll need a fair amount of patience, especially as you have to install the case around your hardware in some cases. Thankfully, the X1.0 is considerably smaller than the S2.0, so it's generally much easier to build. In fact, its dimensions of 250 x 310 x 244mm (W x D x H) make it one of the smallest cases we've ever reviewed, being less deep than even the positively microscopic Cooler Master Elite 130 too.

The X1.0 uses SFX PSUs, with the PSU mount behind the motherboard

As with the S2.0, the X1.0 is available in a range of colour combinations, including a mix of black with red, blue or white. The coloured sections are overlaid by either black or white fascias, although Parvum Systems will likely cater to your needs if you want a different colour too. The X1.0 uses the same fantastic matt-coated German-made acrylic as the S2.0, which looks and feels fantastic.

Despite being so small, there's room for a 280mm graphics card in the case too, although CPU cooler height is limited to 150mm, which restricts you to low-profile heatsinks or all-in-one liquid coolers. Thankfully, the front 120mm fan mount will easily accept a 120mm-fan all-in-one liquid cooler, and there's enough room for a full-height radiator plus two fans as well, although there's no room for a dual-fan radiator anywhere.

Meanwhile, your motherboard will be mounted inverted with the graphics card at the top, pointing directly at a large air vent in the roof. There's very little clearance in this area, so there are no fan mounts, unlike the S2.0, which sported twin 120mm mounts in this position. However, this situation does mean the graphics card will have easy access to cool air. There's a rear 80mm fan mount too, while Parvum includes one of its own three-speed F1.0 120mm fans for use in the front fan mount.

Perhaps the most interesting move, though, is that the X1.0 uses SFX PSUs, with the PSU mount located behind the motherboard. These power supplies are far smaller than their more common ATX counterparts, and SilverStone now offers models rated at up to 600W. Retailer **www.overclockers.co.uk** currently offers various bundles with the case and an SFX PSU, with an X1.0 and 450W SFX PSU setting you back £164 inc VAT.

The obvious downside here is that you can't transplant your old ATX PSU, but we've found that the latest SilverStone SFX PSUs are just as stable and power-efficient as their larger siblings.

As far as storage goes, there's room for two 2.5in drives, which are suspended from a lateral support beam behind the motherboard tray and screwed into place. However, in addition to the basic drive mounts, there are other few creature comforts with the X1.0. Perhaps the most glaring omission is dust filters for the PSU and graphics card – as a result, you'll certainly need to clean your hardware regularly. Cable routing is also basic, but it's fairly easy to build a clean system inside the X1.0, especially as the PSU and 2.5in mounts are hidden behind the motherboard tray.

The X1.0's build process is also slightly different to that of the S2.0, in that you need to construct the front and middle section first, followed by the power button and USB 3 ports, and then install your hardware before finally fitting the rear panels in place. The reason for this procedure is that the rear panel acts to secure your graphics card in place, which means you'll need to remove that panel whenever you want to extract your graphics card too.

Performance

We installed the included 120mm fan as an exhaust, as it's far better to have one exhaust fan than a single intake. However, even this fan didn't help the X1.0 that much in the CPU delta T graph, where its result of 61°C was one of the warmest mini-ITX case temperatures we've seen. This test

/SPECIFICATIONS

Dimensions (mm) 250 x 310 x 244 (W x D x H)
Material Acrylic
Available colours Black/red, black/blue, black/white, white/black
Front panel Power, 2 x USB 3
Drive bays 2 x 2.5in
Form factor(s) Mini-ITX
Cooling 1 x front 120mm fan (1 x 120mm fan included), 1 x 80mm rear fan mounts (fan not included
CPU cooler clearance 150mm
Maximum graphics card length 280mm

1 The front mount will easily accept a 120mm all-in-one liquid cooler

2 A pair of USB 3 ports and a power button are the only front-panel features

3 Your graphics card will point directly at a large air vent in the roof

was conducted with our small, low-profile test cooler, though, plus the F1.0 fan included was also very quiet indeed, so a larger heatsink or even an all-in-one liquid cooler would improve the situation significantly. Thankfully, the GPU delta T of 44°C was excellent, thanks to the graphics card fan pointing directly at the X1.0's roof vent. Adjusting the fan speed from 12V to 5V made no difference to the GPU delta T, but the CPU delta T rose by 3°C.

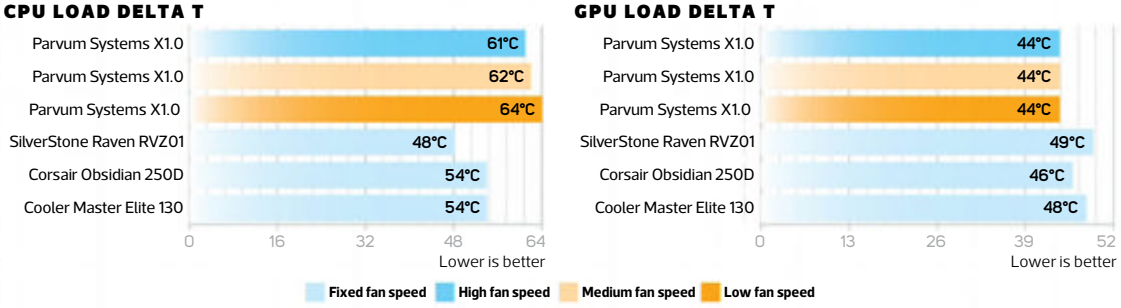
Conclusion

The X1.0 isn't a run-of-the-mill case, but neither is it as easy to use or maintenance-free as your average mass-manufactured enthusiast case. Coupled with the need for SFX PSUs, limited water-cooling potential, a lack of dust filters and a requirement to half-dismantle the case to remove your graphics card or SSDs, it's clear the X1.0 will have niche appeal too.

However, you can't beat the X1.0's looks for modders, and some of the X1.0-based projects we've seen online, courtesy of experienced PC modders, look fantastic. This case will stand out at LAN events, and the gorgeous acrylic also makes it pleasant to touch as well – it isn't often you can use either statement about other mini-ITX chassis.

You need to be aware of the X1.0's shortcomings, though, and for this reason we debated whether or not to give it an Approved award. If a distinctive appearance and customisation options are more important to you than creature comforts and short build times, building and owning an X1.0-based PC will be a rewarding experience.

ANTONY LEATHER



COOLING 21/30

FEATURES 13/20

DESIGN 28/30

VALUE 15/20

OVERALL SCORE 77%

VERDICT

A fantastic-looking case that's great for modders, but be prepared to assemble the case yourself, and to sacrifice water-cooling options and creature comforts.

pcspecialist

PC Specialist recommends Windows 8.1

Minerva

"Under a grand nets you a system that is powerful enough to use in any gaming title you care to play.."
Bryan Water, OC3D.net

- Overclocked Intel® Core™ i5-4690K Quad Core
- **Windows 8.1**
- 16GB HyperX DDR3 FURY 1600MHz
- 120GB HyperX 3K SSD
- 2TB 7,200RPM HDD
- 4GB NVIDIA® GeForce® GTX 970
- 3 Year Standard Warranty

from £999*

Vortex 440

"a true winner of a system; offering great value for money, epic all-round performance and superior build quality."
Ryan Martin, eTeknix.com

- Intel® Core™ Six Core i7-5820K CPU
- **Windows 8.1**
- 16GB HyperX DDR4 Predator 2400MHz
- 240GB HyperX 3K SSD
- 2TB 7,200RPM HDD
- 4GB NVIDIA® GeForce® GTX 970
- 3 Year Standard Warranty

from £1599*

Predator X99

"The Predator X99 is built to very high standards and designed for a myriad of duties including 4K."
Zardon, KitGuru.net

- Intel® Core™ Six Core i7-5820K CPU
- **Windows 8.1**
- 16GB HyperX DDR4 PREDATOR 2400MHz
- 240GB HyperX 3K SSD
- 2TB Seagate SSHD
- 8GB AMD Radeon™ R9 295X2
- 3 Year Standard Warranty

from £2299*

Ultranote II

"what you do get with the UltraNote II is more than just alright. It gets the job done, and does so at a reasonable price."
TechRadar.com

- 15.6" Full HD IPS Display (1920 x 1080)
- Intel® Core™ Quad Core i3-4110M CPU
- **Windows 8.1**
- 8GB Kingston 1600MHz
- 500GB 5,400 HDD
- Intel® HD Graphics 4600
- 3 Year Standard Warranty

from £514*

Optimus V X13

"Need a powerful 13 inch laptop? The Optimus V X13 packs a serious punch!
Zardon, KitGuru.net

- 13.3" Full HD IPS Display (1920 x 1080)
- Intel® Core™ Quad Core i7-4710MQ CPU
- **Windows 8.1**
- 8GB HyperX DDR3 IMPACT 1600MHz
- 1TB Seagate SSHD
- 2GB NVIDIA GeForce GTX 860M
- 3 Year Standard Warranty

from £749*

17.3" Vortex IV

Designed for high end gaming, the 17.3" Vortex IV is an extremely powerful Haswell ready notebook PC with the choice of several extremely powerful graphics cards.

- 17.3" Full HD Display (1920 x 1080)
- Intel® Core™ Quad Core i7-4810MQ CPU
- **Windows 8.1**
- 16GB HyperX DDR3 IMPACT 1600MHz
- 480GB HyperX 3K SSD
- 6GB NVIDIA GeForce GTX 970M
- 3 Year Standard Warranty

from £1509*

SAVE £15 on your order
code:CPC35

Unleash the gamer within you...

AWARD WINNING CUSTOM PCs & LAPTOPS FROM THE UK's LEADING MANUFACTURER!

Vortex 1000 Gaming PC

The Vortex 1000 Gaming PC takes the combined power of Intel's 4th Gen technologoy and NVIDIA GeForce GTX to give you a PC ready for next generation games.

- 4th Gen Intel® Core™ i5-4690K Processor
- **Windows 8.1**
- 8GB HyperX DDR3 BEAST 2133MHz
- 120GB HyperX 3K SSD
- 2GB NVIDIA® GeForce® GTX 760
- Corsair 650W CS Series PSU
- 3 Year Standard Warranty

from £999*

Defiance 980

Get all the power you need to run the latest games with ease, in this slim gaming laptop! Featuring the new 9-Series graphics, you'll never be running low FPS

- 15.6" Full HD Display (1920 x 1080)
- 4th Gen Intel® Core™ i7-4710HQ CPU
- **Windows 8.1**
- 16GB HyperX DDR3 IMPACT 1600MHz
- 120GB HyperX V300 SSD
- 4GB NVIDIA® GeForce® GTX 980M
- 3 Year Standard Warranty

from £1439*

3D Vision 1800 PC

This brilliant gaming PC is everything you need to play games in 3D. With a monitor and glasses included, you are set up and ready to go straight out of the box!

- AMD Eight Core FX-8370 CPU
- **Windows 8.1**
- 32GB HyperX DDR3 FURY 1600MHz
- 120GB HyperX 3K SSD
- 4GB NVIDIA® GeForce® GTX 980
- BENQ 24" 3D Ready Monitor
- Corsair 650W RM Series PSU
- 3 Year Standard Warranty

from £1799*

13.3" Sigma

from £584*

4th Gen Intel® Core™ • i5-4210U Processor • 360° Flip Capability • 10 Point Multi-touch • 13.3" Glossy Full HD IPS • 8GB DDR3 1600MHz RAM • Windows 8.1 • 3 Year Standard Warranty •

0333 011 7000
www.pcspecialist.co.uk

SAVE £15 on your order
code:CPC35

ATX CASE

NZXT H440 Special Edition / £125 inc VAT

SUPPLIER www.overclockers.co.uk / **MODEL NUMBER** CA-H440W-TH

We've seen plenty of great cases from NZXT over the past year. Its £55 S340 picked up an Approved award in our recent budget case Labs, and it even managed to include a PSU cover despite its low price tag. The Phantom 530 went one better and gained a Premium Grade award in our last premium case Labs too. Here, we're looking at one of the company's H-series cases – the H440, where NZXT has teamed up with Razer to create a Special Edition of this popular case.

The standard H440 retails for £90 inc VAT, but the Special Edition costs a fair bit more at £125. So what do you get for the extra cash? The most obvious extra is a green Razer logo on the front of the case. There's another logo inside the case on the PSU cover too, although it's only visible through the side window. These logos make up part of an extensive lighting system that also illuminates the rear of the case, the power button, the bottom of the case and a fair amount of the surface on which the case sits – much like a street-racing car out of Fast & Furious.

The H440 really excels when it comes to water-cooling support

You can turn off all the lights using a switch at the rear, or disconnect individual lights via internal cables. The lighting effect is really well balanced, being sure to turn heads, while also remaining relatively subtle and not too in-your-face. Our favourite part is the internal Razer logo, which appears to be floating thanks to a tinted side window that's also exclusive to this Special Edition. Another feature that really sets this version apart from the cheaper one is the paint finish. The entire case – inside and out – has been coated in a matt black finish, with just a few glossy details around the edges. This effect looks fantastic, and it also helps to make the lighting look tasteful, as it doesn't reflect it.

Meanwhile, the front panel is located at the top, and sports the usual audio jacks plus two USB 2 and two USB 3 ports, with the latter being coloured green.

There are no large vents on the H440 Special Edition and, like the standard model, air is drawn into the case through side vents, with a similar setup in the roof where air is expelled. Both the front and roof panels are removable, allowing you to access the trio of 120mm fan mounts in each location.

The H440 really excels when it comes to water-cooling support too. As well as triple 120mm fan radiator support, there are dual 140mm fan mounts in the roof and front too, again supporting double 120mm-fan radiators. However, the roof section will be limited to a half-height radiator due to the proximity to the motherboard. The front section is riddled with drive bays, which you'll need to remove in order to fit a radiator in the front, but once they're out the way you can house a full-height model here too.

Out of the box, this front section sports three 120mm fans, and the roof section is vacant, but there is one 140mm fan in the rear 120mm/140mm fan mount, which is also a good location for an all-in-one liquid cooler. If you're going to be air-cooling the H440 Special Edition, then a CPU cooler height limit of 180mm will allow you to use any cooler you fancy. Graphics cards are limited to 294mm in length, though, or 406mm if you're able to give up one of the front drive bays. A ten-port fan hub is also included behind the motherboard to cater for the H440 Special Edition's numerous fan mounts.

However, users of optical media need to be aware that, as the front panel uses the same clean, drive bay-free design as the minimalist S340, there are no 5.25in bays, so you can't fit a 5.25in drive. Internally, the H440 Special Edition uses six individual drive mounts located behind the front fans that support either a single 3.5in or 2.5in hard disk or SSD. These mounts can alternatively be removed to make way for radiators or large graphics cards.

In addition, there are two further 2.5in mounts located on top of the PSU cover that can show off your shiny SSDs. The PSU and front section also sport large, removable dust filters as well as noise-absorbing material, and the case generally caters well for cable tidying too. There isn't a whole heap of room behind the motherboard tray, but you also have the whole of the PSU cover to stash your cables.

Performance

The fans proved to offer substantial airflow in the case without making too much of a din but, despite our initial

/SPECIFICATIONS

Dimensions (mm) 220 x 475 x 510 (W x D x H)

Material Steel

Available colours Black/green

Front panel Power, reset, 2 x USB 3, 2 x USB 2, stereo, mic

Drive bays 6 x 3.5in/2.5in, 2 x 2.5in

Form factor(s) ATX, micro-ATX, mini-ITX

Cooling 3 x 120mm/2 x 140mm front fan mounts (3 x 120mm fans included), 3 x 120mm/ 2 x 140mm roof fan mounts (fans not included), 1 x 120/140mm rear fan mounts (1 x 140mm fan included)

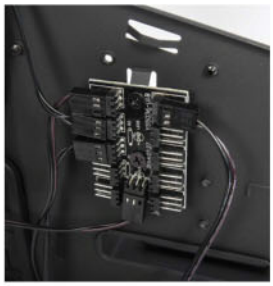
CPU cooler clearance 180mm

Maximum graphics card length 294mm (406mm without drive mounts)

1 The internal Razer logo appears to be floating, thanks to a tinted side window

2 Two 2.5 mounts sit on top of the PSU cover – perfect for showing off SSDs

3 You'll find a ten-port fan hub sitting behind the motherboard



concerns over the lack of large vents, the CPU delta T of 53°C was actually fairly good. It matched Fractal Design's Define R5 on its highest fan speed setting and was only 2°C warmer than NZXT's own Phantom 530.

The SilverStone FT05 offers the best airflow results in this test, though, with a CPU delta T of 42°C. The GPU delta T of 46°C was more competitive, however, and it's clear the trio of fans pointing at the GPU do a good job, coming close to matching the best results we've seen and bettering the majority of cases we've tested.

Conclusion

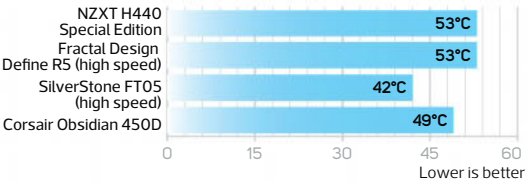
The only parts missing from the H440 Special Edition are a fan controller and a way of mounting an optical drive. SilverStone's FT05 includes both of these features without impacting on its similarly sleek aesthetics, while also offering superior airflow.

Apart from these issues, though, the NZXT offers good cooling, especially for graphics cards; it's more water cooling-friendly than the FT05 and also looks fantastic. The additional elements the Special Edition offers are worth the extra outlay too, and help it to compete well with other cases in its price range.

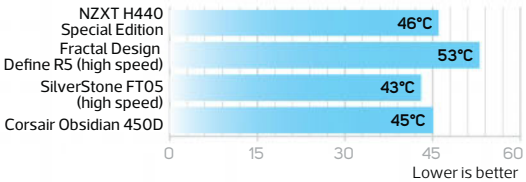
If you're building an air-cooled system, SilverStone's FT05 is the better buy, costing a similar amount of money, while offering better air cooling and fan control. However, if you're after some extra pizzazz, or if you're looking to build a fancy water-cooled rig, the H440 Special Edition is an absolutely cracking case.

ANTONY LEATHER

CPU LOAD DELTA T TEMPERATURE



GPU LOAD DELTA T TEMPERATURE



COOLING	FEATURES
25/30	17/20
DESIGN	**VALUE**
28/30	16/20

OVERALL SCORE
86%

VERDICT

SilverStone's FT05 is better for air cooling, but the H440 Special Edition's great extras and dashing good looks make it a cracking choice for a fancy water-cooled rig.

GAMING LAPTOP

Dino PC Phoenix 17.3in GTX 980M SLI Gaming Laptop / £1,999 inc VAT

SUPPLIER www.dinopc.com

We're used to gaming laptops that compromise in order to balance temperature, cost, weight and battery life, but Dino PC's latest Phoenix laptop casts aside notions of balance. It deploys two GeForce GTX 980M GPUs in SLI to deliver maximum gaming power.

Each GPU has 1,536 stream processors, a core clock of 1,038MHz and a boost speed of 1,127MHz, and each has 8GB of GDDR5 memory clocked to 5,000MHz (effective). The GTX 980M also uses the GM204 architecture – the same Maxwell hardware that underpins the desktop GTX 970 and 980 cards.

The rest of the specification is similarly impressive. The Core i7-4710MQ is a top-tier Intel processor that deploys Haswell hardware at 2.5GHz, and it's paired with 16GB of DDR3 memory. The storage is flat-out too. Dino PC boots Windows 8.1 from a 250GB Samsung 850 EVO SSD, and it's backed up by a 1TB hard disk for data storage.

There's a downside to the Dino PC's monster specification though. The Phoenix weighs a whopping 4.6kg – twice as much as the Gigabyte P35X v3 (see Issue 138, p30), and it's 53mm thick – again, more than twice as thick as the Gigabyte. It will take a good effort to lug this machine to a LAN party on foot, and you'll want a sturdy backpack to keep it safe.

The design is modest too. Matt material is used throughout, with few flashy extras – there's a backlit keyboard, but that's it. Its looks don't stand out, but this heavyweight machine has exceptional build quality – we'd be confident travelling to and from LAN events with it.

Meanwhile, the right-hand side serves up two USB 3 ports and an eSATA port, and the left-hand edge has four audio jacks and a card reader. The machine also has a DVD writer, while another pair of USB 3 connectors and an HDMI output sit on the rear. It has accessible internals too; the hard drive sits beneath one small panel, and removing a larger slab grants access to the memory slots, dual-band 802.11ac wireless card, spare mSATA slot and the cooling gear.

On the plus side, the Dino PC's colossal size gives it room has room for a full-size keyboard and numeric keypad, and it's a traditional unit that eschews the more modern Scrabble-tile design. The base is solid, the keys feel consistent under your fingers, and we were soon typing rapidly.

The keys feel well-made too, although they also feel soft when you press them, without the snap of a proper mechanical desktop keyboard, but that's to be expected in a laptop. Meanwhile, the touchpad is large, but we don't recommend using it for gaming – the surface has too much friction, which meant that finger swipes felt sluggish, and there are no physical, clickable buttons either

/SPECIFICATIONS

CPU 2.5GHz Intel Core i7-4710MQ

Memory 16GB 1,600MHz DDR3

Graphics 2 x Nvidia GeForce GTX 980M 8GB GDDR5

Sound On-board

Screen size 17.3in 1,920 x 1,080

Storage Samsung 850 EVO 250GB SSD, 1TB hard disk, DVD writer

Weight 4.6kg

Ports 4 x USB 3, HDMI, Gigabit Ethernet, eSATA, 4 x audio

Dimensions (mm) 418 x 288 x 53 (W x D x H)

Operating system Windows 8.1 64-bit

Warranty Three years return to base

Performance

The GTX 980M GPUs delivered ridiculous speed. In Battlefield 4, the Dino PC returned a minimum of 92fps – three times faster than most recent gaming laptops, putting it far ahead of the Gigabyte, which used one GTX 980M and didn't drop below 50fps at 1080p.

In Crysis 3, the Dino PC's 61fps minimum also trounced the 37fps scored by the Gigabyte – an incredible result, as consistently maintaining above 60fps in this game is no mean feat for a desktop, let alone a laptop.

Interestingly, the extra GPU didn't make much difference in BioShock Infinite, where the Dino PC hit minimum and average frame rates of 78fps and 133fps, while the Gigabyte managed 77fps and 102fps, although both these results are excellent anyway.

The pair of GPUs, high-end processor and 16GB of RAM also meant that the Phoenix beat rivals in application benchmarks – however, with so many laptops deploying similar hardware, the gap isn't wide. The Dino PC's overall result of 93,007 is the best we've seen from a laptop in our new benchmarks, but it isn't far ahead – the Gigabyte scored 88,611. The Dino PC has the grunt to get through the toughest software, but other laptops are similarly capable.

We expected the powerful hardware to struggle in thermal tests, but the Dino PC's hefty cooling gear, thanks to the larger chassis – and Maxwell's efficient design – helped the GPUs to cope. Their maximum temperature of 85°C is hot, but not toasty enough to throttle, and excess air was pumped from the rear without heating up the chassis.

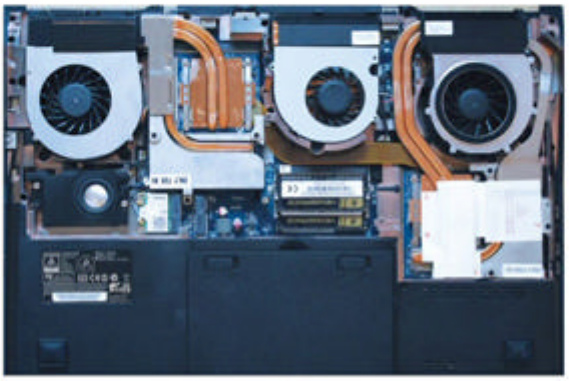
HOW WE TEST
PAGE 34

The noise wasn't bad either. When gaming, the fans ramped up, but we've heard worse – the Dino PC will be drowned out by a headset. The biggest thermal issue came from the processor, which topped out at 97°C during stress testing. That's only a few degrees short of the point at which the Core i7 CPU will begin to throttle, so it's worth bearing in mind if you intend to push the chip for long periods of time.

Meanwhile, this machine's 17.3in screen has a native resolution of 1,920 x 1,080 – a setup with pros and cons. The sensible resolution means there aren't any scaling issues, but the pixel density of 137ppi isn't as impressive as some other machines – the Gigabyte's 15.6in panel had a resolution of 2,880 x 1,620 and a density of 212ppi, which means its graphics will be sharper. On the plus side, though, this laptop will run any current game at maximum settings at its native resolution, and never drop below 60fps.

The panel offers inconsistent quality too. The contrast ratio of 1,250:1 is a good start, and it's bolstered by a superb black point of just 0.26cd/m^2. Those results mean deep blacks and rich colours elsewhere. The delta E of 7.11 is way behind the Gigabyte's 3.66 too, and the 7,913K colour temperature is cool. That latter figure follows through to the sRGB coverage levels – this screen displays 83.2 per cent of the sRGB gamut, with richer colours such as reds, pinks and purples falling short.

Viewing angles aren't great either, with brightness lost from side and vertical viewpoints, and the backlight is inconsistent – 15 per cent of its brightness was lost along the top-right edge, and 13 per cent vanished on the left-hand side. The speakers are mixed as well. They have decent volume and thumping bass provided by a subwoofer underneath, but the top end is intrusively loud and tinny, squeezing out mid-range tones.



Of course, Dino PC's concentration on power means that battery life suffers. We ran a game benchmark with the screen at 100 per cent brightness and the Phoenix expired after just 28 minutes – a new record low for a gaming machine. Dropping the screen brightness only added a couple of minutes to this total too.

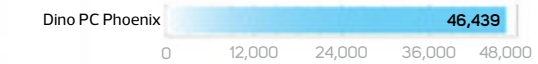
Conclusion

Dino PC's Phoenix is incredibly fast in games, never dropping below 60fps at its native 1080p resolution. However, it's also expensive, costing hundreds of pounds more than the lighter and more attractive Gigabyte. That money might grant you more gaming grunt, but it's at the expense of quality elsewhere. The screen quality is mixed, and the Phoenix is a hefty lump too. If raw portable gaming power is your priority then the Dino PC Phoenix is the king of the castle, but it comes with caveats, and if you're willing to sacrifice a few frame rates, you can get a lighter machine with a better-quality screen for less money elsewhere.

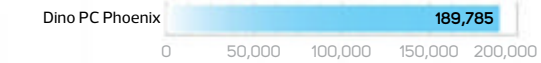
MIKE JENNINGS

CPC REALBENCH 2014

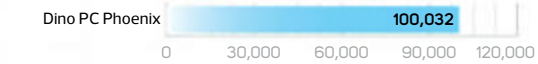
GIMP IMAGE EDITING



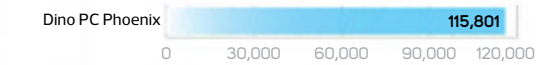
HANDBRAKE H.264 VIDEO ENCODING



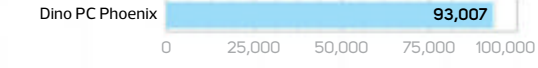
LUXMARK OPENCL



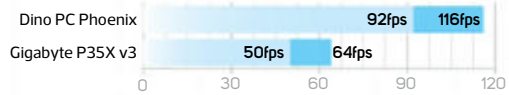
HEAVY MULTITASKING



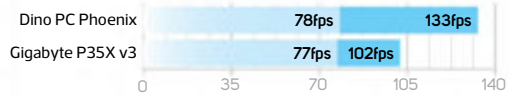
SYSTEM SCORE



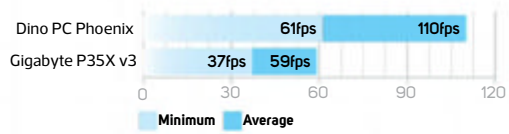
BATTLEFIELD 4
1,920 x 1,080, Ultra Detail, 4x AA



BIOSHOCK INFINITE
1,920 x 1,080, Ultra Detail with Depth of Field



CRYSIS 3
1,920 x 1,080, Very High Detail, 0x AA



SPEED	DESIGN	OVERALL SCORE
25/25	18/25	80%
HARDWARE	**VALUE**	
19/25	18/25	

VERDICT

Never drops below 60fps at its native resolution, which is an incredible feat for a gaming laptop, but you sacrifice weight and screen quality in the process.

www.aria.co.uk

e: sales@aria.co.uk t: 0161 248 1611 Join us on

GLADIATOR AMD FX-8350 GTX960 Gaming PC

: AMD FX-8350 4.00GHz (4.20GHz Turbo) Eight Core CPU / NVIDIA GTX960 2048MB / 8GB DDR3 1600MHz Memory / 2TB SATA III Hard Drive / HD Audio / 24x DVD Re-Writer

powered by GIGABYTE

AMD FX UNLOCKED

NVIDIA GEFORCE GTX

£655.00 inc.VAT

Quick Code #62942

* Web Only Orders (Limited Stock)

Intel i7-4790K Quad Core CPU

4.00GHz (4.40GHz Turbo) / 8MB L3 Cache

CHEAPEST IN THE UK!

*Web Only Orders (Limited Stock)

Quick Code #60941 **£259.99** inc.VAT

EVGA NVIDIA GTX970

Clock Speed: 1216MHz (1367MHz Boost) / 4GB GDDR5

* Web Only Orders (Limited Stock).

Quick Code #62520 **£296.35** inc.VAT

CALL
0161 248 1611
Mon - Fri 9am - 5:30pm

CLICK
www.aria.co.uk
Order online 24/7

VISIT OUR SHOP
More Great Deals!
6 days a week

GOLD AWARD | VALUE AWARD | PC GAMER EDITOR'S CHOICE AWARD | WORTH BUYING AWARD | MUST HAVE AWARD | GOLD AWARD | EDITORS CHOICE AWARD | GAMERS AWARD | SILENCE AWARD | APPROVED AWARD | PC ADVISOR RECOMMENDED AWARD

28" DELL Ultra HD 4K Widescreen LED Monitor

Model: P2815Q

: 3840 x 2160 Resolution Ultra HD / 1000:1 Contrast Ratio / 5ms Response Time
VESA Mountable / 1x HDMI, 1x Display Port, 1x Mini Display Port + 4x USB 3 Hub

4K ULTRA HD

£289.99 inc.VAT

Quick Code #62778

* Web Only Orders (Limited Stock)

2TB Western Digital Black HDD

SATA III 6Gb/s / 7200RPM / 64MB Cache

Web Only Orders (Limited Stock)

Quick Code #59778 **£95.99** inc.VAT

120GB Samsung 840 EVO SSD

Read: 540MB/s, Write: 410MB/s / 94,000 IOPS

Web Only Orders (Limited Stock)

Quick Code #56764 **£53.94** inc.VAT

CALL
0161 248 1611
Mon - Fri 9am - 5:30pm

CLICK
www.aria.co.uk
Order online 24/7

VISIT OUR SHOP
More Great Deals!
6 days a week

HOW WE TEST PAGE 34

GPU COOLER

Arctic Accelero S3 / £35 inc VAT

SUPPLIER www.amazon.co.uk / MODEL NUMBER dcaco-v8300001-gba01

Thanks to improving thermal efficiency, graphics cards sport a huge variety of coolers these days, with some recent GeForce GTX 960 and GTX 970 cards using semi-passive coolers that only spin up their fans during games. Arctic, though, claims its aftermarket GPU cooler, the Accelero S3, offers a passive experience even during games.

It won't cope with a GTX 980, but with a 135W TDP limit, a 120W GTX 960 should be surmountable. The Accelero S3 is also compatible with a range of other graphics cards although some, such as the GTX 650 Ti, should only be used in well-ventilated cases. It can also be used to cool much more powerful models, but requires an optional fan module to boost cooling.

The main section sits atop the PCB and sports four 6mm heatpipes

The heatsink comes in two main parts. The main section sits atop the PCB and sports four 6mm heatpipes, while a large heatsink sits on the rear, dealing with excess heat from the far side of the PCB. Sadly, the huge size of these components means you'll need a sizeable case. The heatsink protrudes outwards by nearly 60mm from the side of the PCB, and the Accelero S3 won't work with most mini-ITX motherboards either, as it fouls the DIMM slots.

Installation is also complicated. It isn't particularly clear what components you need to use for a particular graphics card, and then you have to deal with a mass of washers, screws and thermal pads in addition to a large metal support bracket to cope with the 700g weight. The worst part is dealing with the protective plastic film that protects components on the rear of the PCB from being shorted by the heatsink, which you tediously need to cut to size yourself.

We used a Lian Li PC-A76WX case and a KFA2 GTX 960 Mini OC as our test subject. The stock cooler topped out at a delta T of 53°C under load, although it wasn't particularly loud. The Accelero S3 did manage to keep the temperature at a steady 62°C, but only when installed in a case with a front fan pointed at it. The heatsink was definitely working, but without the fan, the temperatures quickly skyrocketed to unsafe levels.

Arctic lists the GTX 960 as being able to be cooled with little airflow, but it actually needs a fair amount of direct airflow – you're really just moving the active cooling job to a case fan, rather than the GPU cooler. This setup might theoretically result in a slightly quieter PC but, given the low noise levels of so many cards with active coolers (especially with semi passive modes), there won't be much difference.

Conclusion

If you already have a large case with plenty of airflow, the Accelero S3 can effectively cool a GTX 960, albeit at a comparatively toasty temperature. However, actively cooled cards based on Nvidia's latest GPUs run fairly quietly anyway, even in games. Even with AMD GPUs, the Accelero S3's massive size, fiddly installation and lacklustre, case-dependent cooling mean you're better off buying a graphics card with a better cooler instead.

ANTONY LEATHER

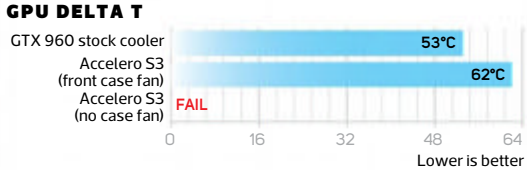
/SPECIFICATIONS

Compatibility See www.arctic.ac for full GPU compatibility list

Heatsink size (mm) 135 x 230 x 42 (W x D x H)

Fans None (optional S3 Turbo module available)

TDP limit 135W



COOLING	DESIGN	VALUE
25/40	17/30	18/30

OVERALL SCORE **60%**

VERDICT

An interesting idea, but the Accelero S3 is too large and fiddly and relies heavily on case airflow.

msi®

MSI recommends Windows.

1st GAMING NOTEBOOK WITH MECHANICAL KEYBOARD

TOUCHPAD WITH NUMERIC KEYPAD

GAME LIKE A GOD

GT80 Titan SLI

GAMING G SERIES

Intel® Core™ i7 Processor.
Explore new ways to learn and stay connected with Intel Inside®.

- MECHANICAL BLACKIC KEYBOARD
- CHERRY MX SWITCH
- MXM SLI GRAPHICS
- SHIFT
- SUPER RAID 3
- COOLER BOOST 3
- AUDIO BOOST 2
- KILLER DOUBLE SHOOT PRO
- STEELSERIES ENGINE
- XSPLIT GAMECASTER
- STEELSERIES KEYBOARD
- DYNAUDIO
- MATRIX DISPLAY

intel inside™ CORE™ i7

Start from £2,099

NO.1 IN GAMING

HOW WE TEST PAGE 34

GAMING HEADSET

SteelSeries Siberia V3 / £70 inc VAT

SUPPLIER www.scan.co.uk

If you've been into PC gaming for any length of time, you may well be familiar with SteelSeries Siberia headset. It's been a mid-range staple in the market for more years than we care to remember, and the V3 version here is an update to the V2 version we saw a couple of years ago (see Issue 118, p74).

Given the Siberia's popularity, it's understandable that SteelSeries hasn't radically tinkered with the formula. The V3 sports the same all-plastic construction of its predecessor, and opts for a similar floating headband arrangement too. This headband has been tweaked and slimmed down slightly, though, helping the headset to tip the scales at only 255g.

Elsewhere, other parts have also been refined in the same gentle fashion. The ear cups have retained their distinctive circular shape (which will be a gripe if you have large ears), but the inlaid detailing has been changed and recoloured, giving the headset more contrast and making it look more attractive. The ear pads have also seen a subtle upgrade from normal foam to memory foam, which should help them hug the contours of a head better.

SteelSeries claims to have completely redesigned the acoustic chamber

The microphone, which handily retracts into the left ear cup when not in use, has been slimmed down too, but we're happy to see it's on the same style stiff wire boom as previous models, as this makes it almost infinitely adjustable. Furthermore, SteelSeries has fitted a dedicated microphone mute switch on the back of the left ear cup – a handy addition, as retracting the microphone doesn't automatically mute it. Internally, SteelSeries claims to have completely redesigned the acoustic chamber and added new driver units. It's also reduced the number of components within each speaker, again trimming down the weight.

Otherwise, though, there's very little to the Siberia V3 – it doesn't have an in-line remote, USB sound card, carry case or replaceable ear pads, and while it's pleasant to not be bombarded by extras and questionable fripperies, it's unusual to see a £70 headset without at least a couple of nick-nacks in the box.

In use, the Siberia V3 is extremely competent. It's fantastically comfortable to wear, thanks to its lightweight floating headband setup. Folks with exceptionally large heads may want to note that there isn't loads of give in the headband – even our normal-sized heads had the elastic on the headband extended almost to its maximum extent.

Audio is rounded and balanced, with no one area of the mix dominating overly. There was a smidgen of bias towards the bass tones, but there's also no denying that such an arrangement lends action games a satisfyingly meaty tone. Mid and high tones were also good, although they noticeably lacked the distinct accuracy and sparkle exhibited by the HyperX Cloud headset in back-to-back testing. That's less of a concern in games, but it's worth bearing in mind if you listen to a lot of classical music through your cans. As there's no accompanying software, you can't tweak the mix either (as was possible on the Corsair Gaming H1500), unless you delve into the Windows audio settings.

Conclusion

The Siberia offers good looks, sound and build quality, and it's light and comfortable to wear too. If you bought it, you wouldn't be disappointed. We would, however, be remiss if we didn't mention that the Elite-listed HyperX Cloud has undergone a price crash (thanks to the impending release of the Cloud II), meaning it can be had for as little as £55. That's £15 less than the Siberia V3 and, with its superior audio quality and bundled extras, it offers better value right now.

PAUL GOODHEAD

/SPECIFICATIONS

Cup type Circumaural
Connection Wired, 3.5mm jacks
Driver(s) Not stated
Frequency response 10Hz to 28KHz
Impedance 35 Ohms

SOUND	DESIGN	VALUE
35/40	26/30	18/30

OVERALL SCORE 79%

VERDICT

A supremely competent and pleasantly lightweight headset, but it's up against stiff competition in this price bracket.

CORSAIR GAMING™

Precision Forged to Win

For years, gamers have trusted Corsair products to build the most powerful gaming PCs. Now you can command that same advanced engineering precision to change the way you play with Corsair Gaming mice, mouse mats, keyboards, and headsets. When it comes to gaming, precision makes the difference.

Find out what Precision Forged gaming looks like at CorsairGaming.com.

> K70 RGB Mechanical Gaming Keyboard with 16.8 million color per-key backlighting

CHERRY

> M65 RGB High-Resolution Laser Gaming Mouse with three-zone 16.8 million color backlighting

> H2100 Wireless Gaming Headset with genuine Dolby 7.1 surround sound

PRECISION FORGED™

How we test

Thorough testing and research is the key to evaluating whether a product is worth buying, and deciding whether or not there's a better alternative

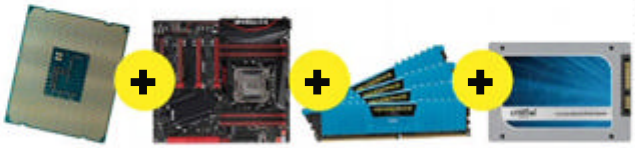
PROCESSORS

We judge CPUs on whether they offer sufficient speed for the price. Part of a CPU's speed score comes from how overclockable it is. Every type of CPU is tested in the same PC, so all results are directly comparable.

INTEL LGA1150

Intel LGA1150 CPU | Asus Maximus VII Ranger | 16GB Corsair Vengeance Pro 1,600MHz DDR3 | 240GB OCZ Vector 150

INTEL LGA2011-V3



Intel LGA2011-v3 CPU | Asus Rampage V Extreme | 16GB Corsair Vengeance LPX 2,133MHz DDR4 | 512GB Crucial MX100

AMD FM2+

AMD FM2+ APU | Gigabyte G1 Sniper A88X | 16GB Corsair Dominator Platinum 2,133MHz DDR3 (GPU testing) | 8GB G.Skill RipjawsX 1,600MHz DDR3 (CPU testing) | 256GB Plextor M5 Pro

COMMON COMPONENTS

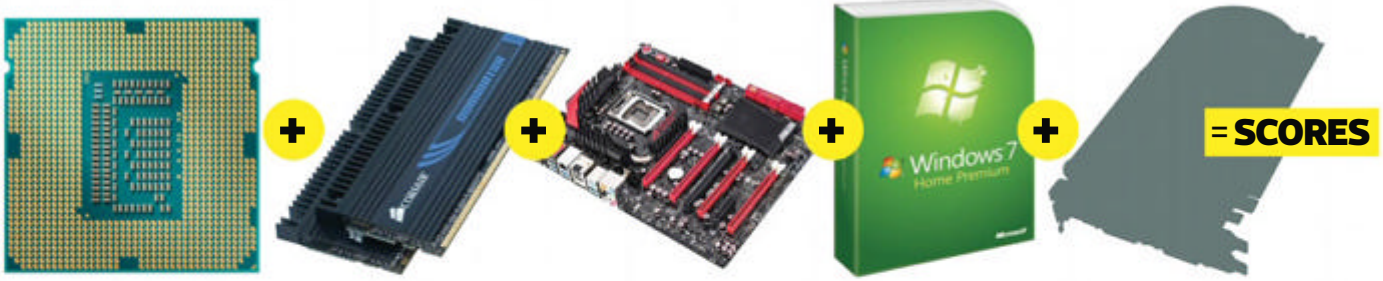
Nvidia GeForce GTX 780 3GB | Windows 7 64-bit

TESTS: We use the Custom PC Media Benchmarks (or CPC RealBench 2014 on LGA2011-V3), Cinebench R11.5 and a variety of games. We also test the power draw of the test PC with the CPU installed. These tests reveal a broad range of performance characteristics, from image editing to gaming and video encoding to 3D rendering. We run all tests at stock speed and again when overclocked to its highest frequency.

*Please note: We test AMD FM2+ APUs using the on-board graphics, not the Nvidia GeForce GTX 780 3GB

GRAPHICS CARDS

Graphics cards are mainly evaluated on how fast they are for their price. However, we also consider the efficacy and quietness of the cooler. Every graphics card is tested in the same PC, so all results are directly comparable.



4.2GHz Intel Core i5-3570K | 8GB Corsair Dominator 2,400MHz DDR3 | Asus Maximus V Extreme | Windows 7 64-bit | The graphics card we're reviewing

CUSTOM PC MEDIA BENCHMARKS

2.66GHz Intel Core 2 Duo E6750 | 2GB of Corsair 1,066MHz DDR2 | 250GB Samsung SpinPoint P120S | Asus P5K Deluxe WiFi-AP

Our benchmark suite simulates how people really use PCs, and a higher score is better. You can download the suite from http://tinyurl.com/CPCbenchies

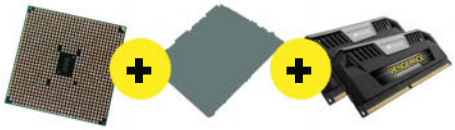
MOTHERBOARDS

Motherboards are evaluated on everything from layout and features to overclockability and value for money. Every motherboard is tested with the same components, so all results are directly comparable.

INTEL LGA1150

Intel Core i7-4790K | Motherboard on test | 16GB Corsair Vengeance Pro 1,600MHz DDR3 | 240GB OCZ Vector 150

AMD FM2+



AMD A10-7850K | Motherboard on test | 16GB Corsair Vengeance Pro 2,133MHz DDR3

INTEL LGA2011-V3

Intel Core i7-5960X | Motherboard on test | Plextor M6 256GB | 32GB Crucial 2,133MHz DDR4

COMMON COMPONENTS

Nvidia GeForce GTX 780 3GB* | Windows 7 64-bit

TESTS: We use the Custom PC Media Benchmarks (or CPC RealBench 2014 on LGA2011-V3) and several games, and also test the speeds of the board's SATA ports. We try to overclock every motherboard we review by testing for a maximum QPI, base clock or HTT as well as overclocking the CPU to its maximum air-cooled level. We run our tests at stock speed and with the CPU overclocked.

*Please note: We test AMD FM2+ motherboards using the on-board graphics, not the Nvidia GeForce GTX 780 3GB

TESTS: By using the fast PC detailed on the left, we can be sure that any limitations are due to the graphics card on test, rather than being CPU limited. We test the four games (above) at their maximum detail settings, in their highest DirectX mode, at several resolutions. High-end cards should be able to sustain playable frame rates at 2,560 x 1,440, while 1,920 x 1,080 is more important for mid-range cards; we also test at 3,840 x 2,160 for 4K monitors, and try to overclock every graphics card we test to assess the performance impact.

The Awards

EXTREME ULTRA
Some products are gloriously over the top. These items of excellent overkill earn our Extreme Ultra award.

PREMIUM GRADE
Premium Grade products are utterly desirable – we'd eat nothing but beans until we could afford them.

PROFESSIONAL
Products worthy of the Professional award make you and your business appear even more awesome.

APPROVED
Approved products are those that do a great job for the money; they're the canny purchase for a great PC.

CUSTOM KIT
For those gadgets and gizmos that really impress us, or that we can't live without, there's the Custom Kit award.

SUBSCRIBE NOW!

Subscribe to **CUSTOM PC** today and save on the single issue price.

Each issue of ***Custom PC*** will be delivered directly to your device each month.

SEE NEXT PAGE FOR SET-UP INSTRUCTIONS

HOW TO SUBSCRIBE...

...on an iPad or iPhone

STEP 1 Return to the ***Custom PC*** library

STEP 2 Choose your subscription term and tap twice on the 'price' box

STEP 3 Choose whether to create an optional PixelMags account

STEP 4 Enter your Apple ID password to confirm

Download on the App Store

...on a Kindle Fire

Kindle Fire subscriptions come with a FREE one month trial.

STEP 1 Tap 'Free Trial Subscription' in the ***Custom PC*** library

STEP 2 Chose your subscription term from the drop down menu on the popup that appears

STEP 3 Tap 'Subscribe'

available on kindle fire

...on an Android device

STEP 1 Open the Google Play Store homepage and navigate to the Newsstand section using the tabs at the top

STEP 2 Search for ***Custom PC*** using the search icon in the top right of the screen

STEP 3 Click the 'Subscribe' button and pick your term

STEP 4 Enter your Google password to confirm

android

...via the Zinio app

STEP 1 Search for ***Custom PC*** via the search box in the Shop tab

STEP 2 Tap the 'Subscribe' button

STEP 3 Choose whether to create an optional Zinio account

STEP 4 Enter your Apple ID password to confirm

Subscribe to *Custom PC* today and save on the single issue price

Custom Kit

Paul Goodhead checks out the latest gadgets, gizmos and geek toys

PHONE CHARGING KIT

Patriot FUEL iON Galaxy S4 Case & Stand / £56 inc VAT Car Mount / £39 inc VAT

Patriot is straying a long way from its storage roots with the FUEL iON range of phone chargers, but that hasn't stopped the company from making some bold claims about them. Based on using magnets to hold a charging connection between the case and a stand, Patriot claims it can offer a charge speed twice as fast as competing Qi wireless chargers. The claim bore up under testing too – after 15 minutes, the FUEL iON charged our test phone to 14 per cent battery compared to 7 per cent on our Qi Pad.

However, while you don't have to plug in wires, the metal contacts still have to touch for charging to commence. Happily, the magnets that hold the contacts in place are strong, so you only need to position them roughly in the right place to see the case pop into place. The magnets also mean the charger can hold the phone upright during charging,

Galaxy S4 Case & Stand

Car mount

which is a definite advantage on a desk, and also enables you to use add-ons such as the car mount, which holds the phone in place while it's charged.

Naturally, buying into a proprietary technology such as FUEL iON has disadvantages – once you're in, you're locked in, so Patriot can charge you what it wants for accessories (£39 for the car mount is outrageous), and you're unlikely to be able to charge your phone at your mate's house, as you may be able to do with the Qi Pad. As a technology, though, it delivers, as long as you're happy to buy into it.

CASE & STAND: FALL BACK ●●●●● CHARGE

CAR MOUNT: EDISON ●●●○○ TESLA

SUPPLIER www.amazon.co.uk

ICE MOULD

Death Star Ice Mould / £10 inc VAT

The first question we were asked when the Death Star Ice Mould landed in the office was, 'Why?', to which our only response was, 'Why not?' After all, what's more jolly than seeing a mini replica of the most powerful battle station to ever grace a galaxy far away slowly chill down your chosen beverage? The resulting cube even plinks and cracks dramatically when you first pour liquids over it, as if a mini ice Luke Skywalker is dumping proton torpedoes into a tiny ice exhaust port.

At around the size of a tangerine, you'll need to check you have a glass wide enough to accommodate the finished Ice Star, of course, but otherwise, it's a sure fire way to geek up any liquid refreshment.

EPISODE I ●●●●○ EPISODE V

SUPPLIER www.firebox.com

BLUETOOTH SPEAKER

Divoom Voombox Ongo / £60 inc VAT

Bluetooth speakers are ten a penny these days, so odd features are creeping into the market as brands attempt to make their products stand out. The Ongo, for example, is bundled with a bike handlebar mount – a questionable addition at best. We can't work out exactly who would think it suitable to inflict their musical tastes on everyone within earshot while cycling, but we know we'd rather not meet them.

Interestingly, the speaker itself is good. It's ruggedised and water-resistant, and it's a good size too – small enough to be discreet, but still large enough to provide a surprisingly decent bass response. There was less volume available than we expected, but there's enough quality on offer to justify the £60 asking price.

CLANGIN' ●●●●○ **BANGIN'**

SUPPLIER www.maplin.co.uk

POWERPACK

PNY LM3000 / £30 inc VAT

The LM3000 is the latest addition to PNY's ever-growing range of portable power packs, and it's also one of the easiest to use, thanks to its integrated micro-USB and Apple Lightning connectors, which cleverly spring out of the sides when needed. Integrating the output connectors in this way means there's no need to carry a charging cable at all times, although you still need a cable to charge the pack itself. With 3000mAh on tap, the LM3000 charged our test Nokia phone's battery once fully, then by 8 per cent a second time around. That's hardly likely to get you through a music festival, but it will do for a weekend away.

FLAT ●●●●○ **FULL**

SUPPLIER www.amazon.co.uk

PHONE CASE

QDOS Portland /

£25 inc VAT

If you have a shiny new iPhone 6, then QDOS would like you to consider clothing it in its new Portland case. Available for both the normal and oversized models, the Portland is really two cases. The inner case is rubber and fits tightly around the phone, while the second outer case (which clips around the inner case) is made from stiff plastic, with hinges running through it both vertically and horizontally. Therefore, unclipping two neighbouring edges of the outer case instantly creates a simple stand for the phone. Voilà!

Annoyingly, the entire escapade is let down by the smooth plastic of the outer shell – it's slippery if you're wearing gloves and looks cheap too.

Can we have a version with a soft-touch finish please?

GAS BILL ●●●○○ **PORTLAND BILL**

SUPPLIER www.qdossound.com

Seen something worthy of appearing in Custom Kit? Send your suggestions to paul_goodhead@dennis.co.uk

Graphics cards

New GPUs and massive price cuts – we lock and load our new benchmarks to find out which GPUs offer the best bang for your buck

Few areas of PC technology move faster than graphics cards, but the past year has been especially volatile for Nvidia and AMD. The green team has released a raft of new Maxwell-based GPUs, with the high-end GTX 980 and 970 in the autumn joined by its latest card, the mid-range GTX 960, in January.

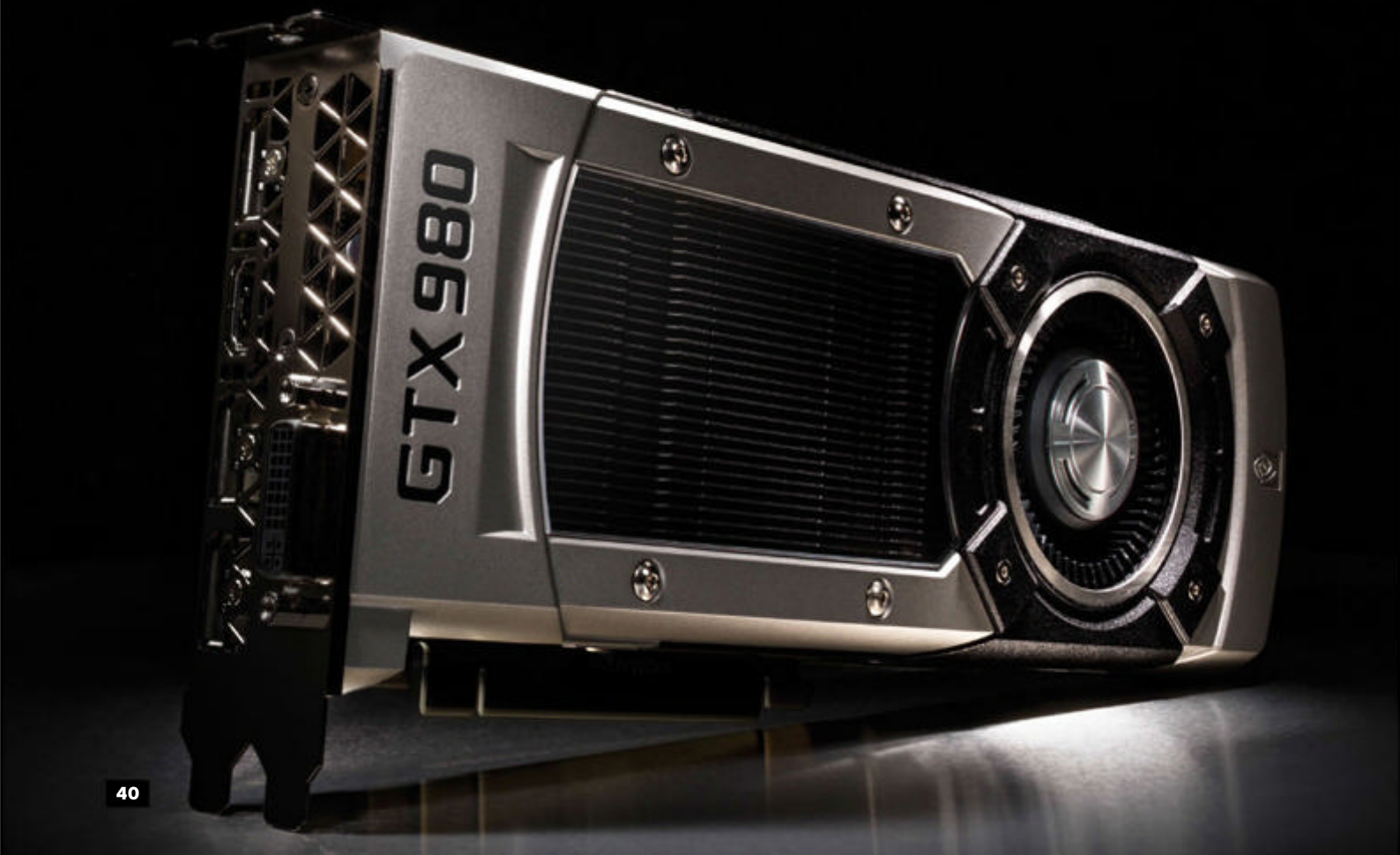
Meanwhile, AMD hasn't been busy launching new GPUs – its R9 200-series of chips arrived a year before Nvidia's Maxwell chips and was fully completed by September last year. Instead of unleashing new hardware, though, it's been cutting prices – virtually every one of its chips is now significantly cheaper than at launch. AMD's price cuts and Nvidia's new cards both significantly change the landscape, which is why we've locked every top-end and mid-range GPU into our test rig.

The key to our tests is finding which card delivers the best bang per buck, as it's no good spending hundreds on the fastest card around if it's barely any quicker than a GPU that's £200 cheaper. We've tested at 1080p, 2,560 x 1,440 and 4K to discover which card offers the smoothest play and the best value at these three resolutions, and we've also enlisted some new games, including Shadow of Mordor and Alien: Isolation.

Gaming at 4K is still tricky for even powerful cards, so we've investigated multi-GPU setups. Then, at the other end of the scale, we've explored several budget cards to find out if you have to spend more than £100 to get smooth 1080p gaming, or if it's better to save a little more cash for a mid-range card.

MATTHEW LAMBERT AND MIKE JENNINGS

Featured this issue



How we test

All our graphics cards tests are performed on a high-end Ivy Bridge system, which features an Asus Maximus V Extreme LGA1155 motherboard and an Intel Core i5-3570K running at 4.2GHz. Alongside these components are 8GB (2 x 4GB) of Corsair Dominator 2,400MHz DDR3 RAM and a 256GB Samsung SSD 840 Pro SSD. Meanwhile, power comes from a LEPA G1600 1,600W PSU, capable of powering up to four high-end graphics cards in SLI or CrossFire configurations.

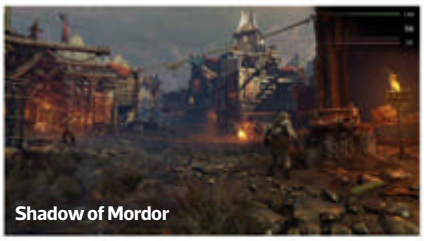
We've tested each card in four games. For Alien: Isolation, we record the first 60 seconds of the built-in benchmark (the most demanding section). Our Battlefield 4 test uses a 60-second sequence from the start of the single-player campaign mission Tashgar, while Crysis 3 is tested using a custom, 60-second macro-recorded play-through from the single-player mission Red Star Rising. Finally, we record 35 seconds of Middle Earth: Shadow of Mordor's built-in benchmark. We record every test using the freely available FRAPS tool to ensure accuracy, and each test is performed three times for consistency.

Games are tested at 1,920 x 1,080 (1080p), 2,560 x 1,440 and, for higher-end cards, 3,840 x 2,160 (4K). Typically, each game is tested at its highest detail preset with v-sync disabled. However, at 4K resolution, anti-aliasing is disabled in Battlefield 4, and Shadow of Mordor is dropped from Ultra to Very High, as the tests are otherwise too demanding for any cards to achieve meaningful results. We also leave anti-aliasing disabled at all resolutions in Crysis 3, again because it's overly demanding.


Alien: Isolation


Battlefield 4


Crysis 3


Shadow of Mordor

Scoring standards

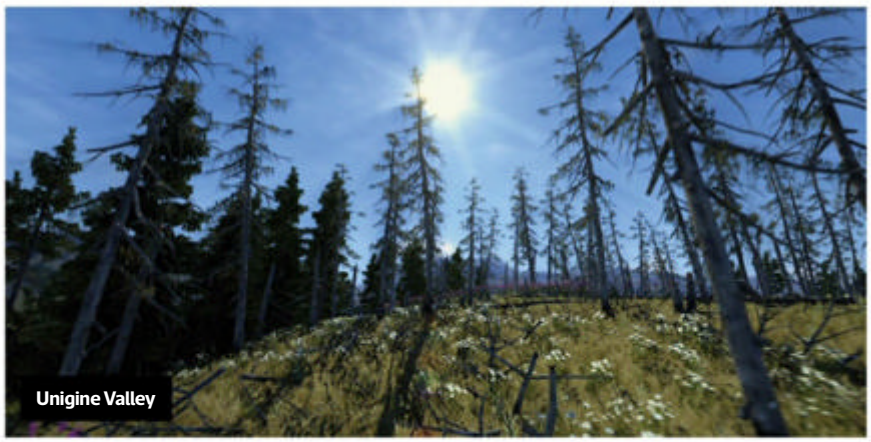
We've adopted a scientifically calculated weighted scoring system for GPU group tests that's designed to highlight meaningful and real-world performance differences. The Performance component of the final scores is calculated through a point-based system, with points allocated based on the minimum frame rate achieved in each test. We focus on minimum frame rates, as it's this metric that you'll really notice when your games slow down.

We consider a minimum of 30fps to be the ideal target for games to remain smooth and playable. As such, a minimum of 30fps or more is worth three points. If a minimum result exceeds 60fps, we award one bonus points on top, as 60fps is the golden goal, while a result of between 25fps and 29fps (which we consider to be on the borderline of playable) receives one point. We use these points to calculate a Performance percentage for each resolution; 1,920 x 1,080 carries the heaviest weighting of the final score (25 per cent), followed by 2,560 x 1,440 (20 per cent) and 4K (15 per cent).

The Value score (30 per cent) is then calculated by dividing the total performance points by the cheapest available model of a given GPU at the time of writing. The final 10 per cent comes from the Efficiency score, which is based on how well the card performs across the tests compared to its power consumption under load.

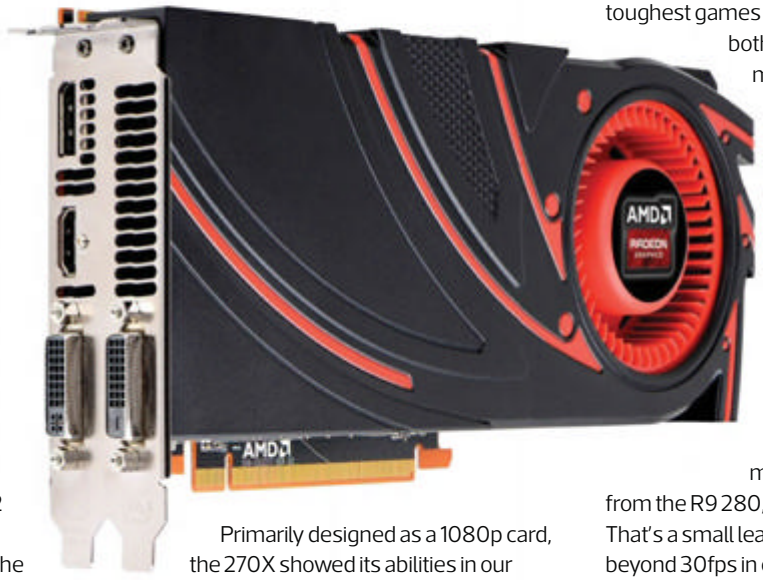
While this scoring method appears convoluted, it puts the onus on real, useful performance in current-generation games. After all, if one card manages a minimum frame rate of 4fps, and another manages 9fps, the latter card doesn't really 'win', as both are ultimately useless in that game. Likewise, you won't notice the difference between a card getting 110fps and 116fps.

We've also included results for Unigine's Valley benchmark, a demanding DirectX 11 test. It's run at 2,560 x 1,440 at Ultra detail with anti-aliasing disabled. Our result is the average of three runs. Finally, we've tested each GPU in Folding@home (GPGPU floating point calculations) using FAHBench, which uses the OpenCL framework. As we've prioritised performance in real games, neither Unigine nor GPGPU performance factors into the overall scores, but their results can be found on p54.


Unigine Valley

AMD Radeon R9 270X 2GB / £126 inc VAT

SUPPLIER www.ebuyer.com



The R9 270X has been our top option for 1080p gaming since its release in October 2013, when it cost around £155. AMD's recent price drops mean it now costs just £126, getting you a Pitcairn-based GPU that first appeared in the Radeon HD 7870, so it's really a cut-down version of the Southern Islands architecture that still underpins the R9 280 and 280X.

The R9 270X has 1,280 stream processors compared to the 1,792 and 2,048 in AMD's more expensive mid-range cards, and the 2GB version we've tested has a 256-bit memory bus – narrower than that of AMD's pricier GPUs. The older architecture means the R9 270X misses out on some software features too, with no sign of TrueAudio or Mantle support.

Primarily designed as a 1080p card, the 270X showed its abilities in our game benchmarks. In Alien: Isolation, its minimum of 57fps is only 3fps short of the magic 60fps top target, and in Battlefield 4 it never dropped below 36fps – still a very respectable result.

Crysis 3 and Shadow of Mordor are the two toughest games in our current suite, and in both, the 270X returned minimums of 28fps. That's above our base-minimum target of 25fps, so these games are playable on the 270X, but it's not quite enough to grasp our ideal playable frame rate of 30fps. To get perfectly smooth play in tougher games, you may have to turn down quality settings.

However, AMD's recent price drops mean this GPU's main competition now comes from the R9 280, which costs just £14 more. That's a small leap, but the R9 280 goes beyond 30fps in every 1080p game test – a feat the R9 270X can't manage. The R9 270X doesn't have the power for playing at higher resolutions either. In Alien: Isolation at 2,560 x 1,440, the 270X maintained a minimum of 34fps, but in our other three games, it languished below 25fps.

AMD Radeon R9 280 3GB / £140 inc VAT

SUPPLIER www.ebuyer.com

The R9 280 is one of several AMD GPUs that recycles older hardware – in this case, it's the Radeon HD 7950 Boost. There's no new GPU, then, but the price of £140 is £20 less than Nvidia's GTX 960. The 28nm Tahiti GPU used for this card has 1,792 stream processors divided into 28 compute units, and its stream processors are clocked to 933MHz – higher than the older card, perhaps, but lower than every other chip in AMD's mid-range GPU stack.

The memory situation is better. The R9 280 has 3GB of GDDR5 memory and a 384-bit memory bus – better than the R9 270X and R9 285, both of which have 2GB of memory and narrower interfaces. However, the use of an older architecture means there's no sign of TrueAudio or FreeSync support – to get these features, you'll need to buy the R9 285.

The increased power and memory performance helped the R9 280 to deliver a solid set of 1080p results. Its Alien: Isolation minimum frame rate of 66fps is 6fps better than our gold standard for perfectly smooth gameplay, and in Battlefield 4, the R9 280 never dropped below 39fps – another result that's beyond one of our key targets. In Crysis 3, we recorded a minimum of 35fps, and 38fps in Shadow of Mordor.

Those 1080p results are all smooth, and the 280 almost carried its good form up to 2,560 x 1,440. In Alien and Shadow of Mordor, the R9 280 hit minimums of 44fps and 30fps respectively – good enough for smooth play. In Battlefield 4 at this higher resolution, the 280 also managed a borderline playable 26fps, but it languished to 21fps in Crysis 3.

The R9 280 also delivered the best power consumption figures of both the R9 285 and 280X, with our system consuming 255W at peak load with the R9 280 installed, ducking

The 270X's older architecture means its efficiency is comparatively uncompetitive too. Our system's 104W idle power consumption with the 270X installed wasn't anything to shout about, and its 238W peak was similarly high for the frame rates on offer.

Conclusion

The 270X remains a good card for 1080p gaming – if you already have one, there's nothing to worry about. However, AMD's recent price drops have now made the R9 280 a far better affordable option. It only costs £14 more and, for that money, you get a card that never drops below a 30fps minimum at 1080p. **MJ**

1920 SPEED	2560 SPEED	3840 SPEED
13/25	3/15	0/10

VALUE	EFFICIENCY
25/40	5/10

VERDICT

Still a good 1080p GPU, but AMD's price cuts mean there are now better options.

OVERALL SCORE 46%

well below the 280X's 326W. It's still more power-hungry than the GTX 960 though – Nvidia's newer hardware definitely has the upper hand when it comes to efficiency.

Conclusion

The R9 280 has seen a significant price cut, and that means its revised £140 price is now just £14 above the R9 270X, while offering more consistent 1080p pace. It offers much more bang for your buck than Nvidia's GTX 960 too, despite costing £20 less. The lower price and solid 1080p performance make the 280 our new 1080p card of choice, and the worthy winner of an Approved award. **MJ**

1920 SPEED	2560 SPEED	3840 SPEED
20/25	7/15	0/10

VALUE	EFFICIENCY
40/40	6/10

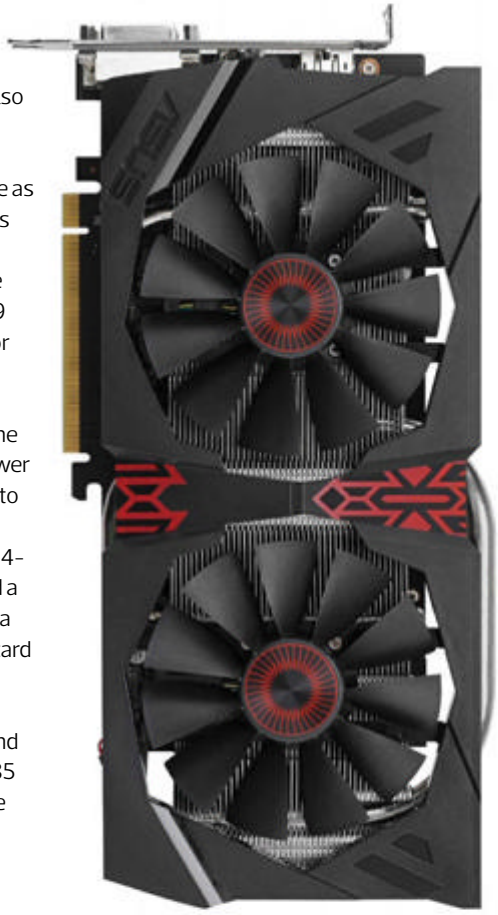
VERDICT

Now a great affordable 1080p card, thanks to recent price cuts. It never drops below 30fps.

OVERALL SCORE 73%

AMD Radeon R9 285 2GB / £144 inc VAT

SUPPLIER www.ebuyer.com



AMD's Radeon R9 285 is ostensibly the newest GPU in AMD's current range, but it's also one of the strangest. It has the same number of stream processors, and the same older HD 7950-based architecture as the R9 280, but those stream processors are divided into a more parallel arrangement with a wider front end. The R9 285 also hasn't replaced the older R9 280, which is still widely available and for a similar price to the R9 285.

The revised stream processor arrangement isn't the only area where the R9 285 differs from the R9 280. The newer card has less memory – 2GB compared to the older card's 3GB – and it's accessed with a 256-bit interface, rather than a 384-bit bus. The R9 285's memory is clocked a little faster, but we're not convinced that a bit of extra speed is enough to help the card overcome the deficiencies elsewhere.

This opinion is backed up in our benchmarks. The tiny price difference and revised architecture didn't see the R9 285 deliver any performance boosts over the older card. The R9 285 played Alien Isolation at a minimum of 59fps and the rest of our test games with minimums between 32fps and 38fps. They're decent results that means games will always be playable at 1080p, but it's no better than the R9 280.

The 285 also failed to impress at 2,560 x 1,440. At this more demanding resolution, the newer AMD card only got beyond our 30fps target in Alien Isolation – in our other three games, its 24fps minimums were just behind the 25fps figure we consider the bare minimum for playability. Again, these figures make it slower than the older Radeon R9 280.

Little stood out about efficiency either. Our PC drew 269W with the R9 285 installed – higher than the R9 280's 255W, despite the latter part being faster, and it's much higher than the Maxwell-based GTX 960's power consumption, which drew just 228W from the mains.

Conclusion

AMD's architectural changes to the R9 285 result in a more parallel stream processor arrangement and less memory clocked at a higher speed, when compared to the R9 280, but these changes clearly hinder the R9 285's performance.

The R9 285consistently falls behind AMD's R9 280 and, at 1080p, it's no better than Nvidia's GTX 960. The R9 285 is a reasonable 1080p card, but the R9 280 is faster and a tad cheaper, making it a much better buy. **MJ**

1920 SPEED	2560 SPEED	3840 SPEED
19/25	3/15	0/10

VALUE	EFFICIENCY
31/40	6/10

VERDICT

Despite being a new GPU, it's slower and more expensive than its older counterpart.

OVERALL SCORE 59%

Budget GPUs examined

Is it possible to get good gaming performance on the cheap? We delve into AMD and Nvidia's budget alternatives

The cheapest card in this Labs test costs £126 but, if you listen to AMD and Nvidia, you only have to spend £100 to net cards that game comfortably at 1080p. Lower prices aren't the only advantage at this end of the market either. The modest thermal demands of cheaper products mean that board partners have plenty of design freedom, so small, quiet cards are easy to find – ideal if you're building a passively cooled HTPC or a very small form factor system.

We've benchmarked some of the most popular budget GPUs to see if they're realistic, cheaper alternatives to this month's award winners. We tested AMD's Radeon R9 270, R7 265 and R7 260X, plus Nvidia's GeForce GTX 750 and 750 Ti – all the results are at the back of this Labs test.

The AMD cards are available in mini-ITX designs, and even reference cards are only 210mm long – shorter than most mid-range graphics cards. They don't make huge thermal demands, either, so each requires just one 6-pin PCI-E power connector. Nvidia's card GTX 750 Ti is more versatile. It uses the Maxwell architecture, which is more efficient than AMD's latest architecture, so it doesn't need any power connectors – all of its electricity comes from the PCI-E slot. Small, single-fan versions are commonplace, and passive parts are also available.

On paper, there are tempting reasons to investigate budget GPUs, but there's no denying their lack of pace. At 1080p, the R9 270's minimum went beyond 50fps in Alien and 30fps in Battlefield 4, but it could only manage a minimum of 26fps in the Crysis and Shadow of Mordor benchmarks – results that are only 1fps better than our bare minimum to be playable. The R7 265 was even worse – below 30fps in Battlefield, and under 25fps in Crysis 3 and Shadow of Mordor.

It's the same story with Nvidia's GeForce GTX 750 Ti, which is slower than both AMD chips. It could only manage a 25fps minimum in Battlefield 4, and a juddering 20fps in Shadow of Mordor.

AMD Radeon R7 260X

Nvidia GeForce GTX 750 Ti cards can be fitted with passive coolers

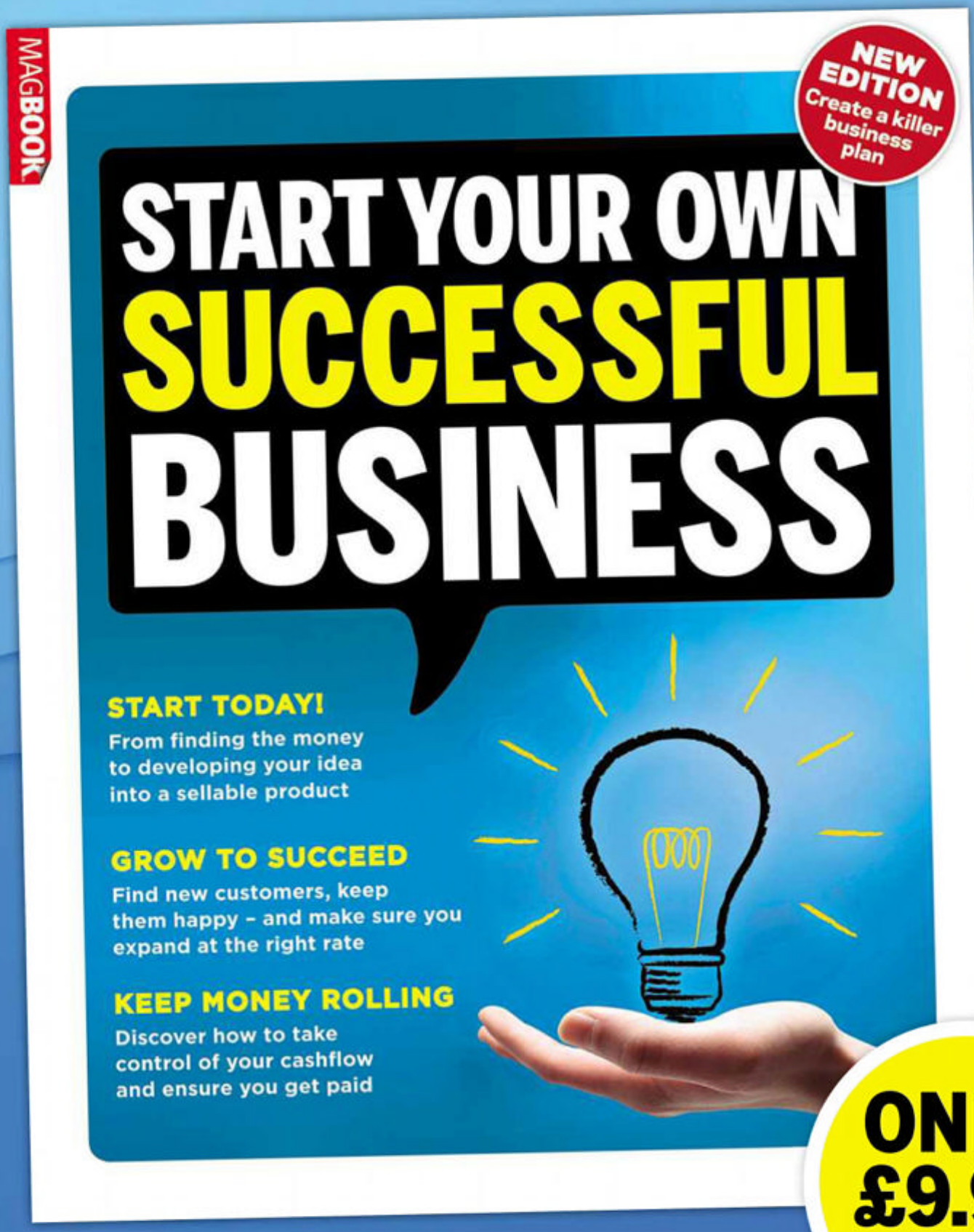
These scores mean many games won't run smoothly unless their resolution and quality settings are compromised – even the R9 270, which is the fastest of these chips, couldn't manage 30fps in half of our tests. That's no good for current titles, and that situation won't improve over the next year or two, as games become more demanding.

Our tests prove that you'll get much better value for money if you save your cash so you can spend a little more. Our favourite 1080p card is now AMD's Radeon R9 280, which is only £30 more than the R9 270 but provides a far more satisfying balance between price and performance: it hit a minimum of at least 35fps in every 1080p test, and its 66fps minimum in Alien: Isolation is superb.

Budget cards are clearly not the best options for gaming, but they still have their place. The cards we've tested might not be ideal for gaming at maximum settings, but not every PC has room for a large graphics card, and not everyone has the budget. If you're willing to drop a few of your game settings, a GPU such as the R9 270 will still suffice if you really can't afford to spend any more money.

So budget graphics cards have their uses, but they just don't have enough power to sate anyone who takes gaming seriously. When the difference between borderline playable performance and smooth 1080p playback is as little as £30, we recommend saving some extra cash or making sacrifices in other areas instead of scrimping on the graphics card.

ON SALE NOW



ONLY £9.99

Order your print or digital MagBook at **magbooks.com**

Nvidia GeForce GTX 960 2GB / £160 inc VAT

SUPPLIER www.scan.co.uk

It's taken a few months for a mainstream, mid-range card to arrive with Nvidia's new Maxwell hardware inside, but the GTX 960 is now here, with a £160 price that now pushes this card into competition with AMD's R9 280 series. The Maxwell architecture is all about doing more with less, with efficiency a key focus. Nvidia has redesigned its stream processors and arranged them into revised graphics processing clusters (GPCs) – in this hardware generation, stream processors are split into smaller blocks that have their own warp and scheduling hardware.

It's a change that means Nvidia can delegate the GPU's tasks more effectively, and it also means that less of the complex resource-sharing hardware from the last generation is required. Nvidia says these changes improve performance by between 35 and 40 per cent per stream processor in shader-limited workloads, but with two thirds of the number of stream processors used in its previous generation of GPUs.

The GM206 GPU used inside the GTX 960 is a direct successor to the GK106 used inside the older GTX 660. It has 2.94 billion transistors and uses the same streaming multiprocessor (SMP) design as the GTX 980, so each SMP has four blocks of stream processors, with those SMPs arranged into GPCs. The GTX 980 boasted four GPCs with 13 stream processors in each, while the GTX 960 has two GPCs with eight stream processors each – a change that means the mid-range card has 1,024 stream processors, which is half as many as the GTX 980.

The memory is cut down too – the GTX 960 has 2GB of GDDR5 memory, accessed with a 128-bit bus. Both of those attributes are sliced in half when compared with the GTX 980. The 7GHz (effective) memory speed, at least, matches the more expensive card.

The GTX 960's mainstream specification tempered our performance expectations. When tested at 1080p, it only managed to break through the 60fps barrier in one game – Alien: Isolation – and in the tougher Shadow of Mordor benchmark, it could only manage a minimum frame rate of 25fps, which is the minimum we consider for to be playable.

That's disappointing performance when compared with AMD's alternatives. Every one of the Radeon R9 280-series cards never dropped below 30fps in all of our 1080p tests. The GTX 960 didn't have much success at 2,560 x 1,440 either. In Alien: Isolation, the GTX 960 managed a smooth minimum frame rate of 43fps, but the minimum was below 25fps in every other test – and consequently unplayable. AMD's Radeon R9 285 performed similarly in these tougher tests, but the R9 280 and R9 280X both proved more adept at 2,560 x 1,440.

On the plus side, the Maxwell architecture has consistently proved itself to be efficient, and the GTX 960's power consumption figures illustrated how Nvidia has tried to do more with less. Our system drew just 104W when idle with the GTX 960 installed, topping out at 228W – far lower than with any Radeon R9 280-series GPU.

Conclusion

The efficient architecture and decent price would usually bode well for the GTX 960's prospects, but AMD's recent aggressive price cuts causes serious damage, with the R9 280 being both faster and cheaper. However, Maxwell's power consumption figures mean it's possible to get silent, semi-passive and small form factor versions of the GTX 960, which makes them ideal for 1080p budget or mini-ITX gaming machines. For every other type of machine, though, the R9 280 offers much more in terms of bang per buck. **MJ**

1920 SPEED	2560 SPEED	3840 SPEED
17/25	3/15	0/10

VALUE	EFFICIENCY
26/40	8/10

VERDICT

Impressively efficient, but lacks performance when compared to similarly priced AMD hardware.

OVERALL SCORE 54%

ON SALE NOW

Order your print or digital MagBook at **magbooks.com**

AMD Radeon R9 280X 3GB / £176 inc VAT

SUPPLIER www.scan.co.uk

The Radeon R9 280X might have a modern-sounding name, but it's based on hardware from 2011 – the Radeon HD 7970, although its 28nm Tahiti GPU still boasts an impressive specification. It has 2,048 stream processors and a maximum clock speed of 1GHz, plus 3GB of GDDR5 memory with a 384-bit bus – more memory and a wider bus than most of AMD's other mid-range cards.

However, this is another AMD card that doesn't benefit from support for new features such as TrueAudio and FreeSync, which are only supported by cards based on AMD's newer GPU architecture.

The R9 280X costs a sliver more than its key competitors, but that extra cash nets you a card that dominates our 1080p tests. Its minimum frame rate eased beyond the perfect 60fps target in Alien: Isolation, and it easily went beyond 30fps in the rest of our games benchmarks – our ideal minimum figure for consistently smooth gameplay.

The R9 280X's immediate competitors all managed to go beyond that 30fps barrier in our 1080p tests, so there's plenty of choice in this area of the market, but the R9 280X proved the fastest when lined up against the other R9 280-series GPUs and Nvidia's GTX 960.

The mid-range Radeon proved adept at 2,560 x 1,440 too. It never dropped below 30fps in three of our game tests, with its lowest result coming with a 27fps minimum in Crysis 3, which is still above the 25fps minimum we consider to be playable. That said, however, if 2,560 x 1,440 gaming is your priority, we recommend spending a little more money.

If there's one area where the 280X doesn't succeed, it's efficiency. Our test system's peak power draw of 326W with the R9 280X installed is the highest result from all the 280-series AMD GPUs, and it's more power-hungry than every Nvidia card in this test too.

AMD Radeon R9 290 4GB / £229 inc VAT

SUPPLIER www.ebuyer.com

AMD's Radeon R9 290 uses the Hawaii architecture, sharing its 28nm, 6.2 billion-transistor core with the R9 290X, along with its memory configuration. It has 4GB of 5GHz (effective) GDDR5 memory, accessed using a 512-bit bus that delivers 320GB/sec of bandwidth.

This cheaper card has been created using cutbacks in other departments. It has 40 compute units rather than the 44 inside the R9 290X, so it has 2,560 stream processors – a drop from the 2,816 in AMD's single-GPU flagship. The R9 290's core is also clocked to 947MHz – a tad lower than the 1GHz of the R9 290X – but the Hawaii GPU mean this card supports TrueAudio, FreeSync and CrossFire over PCI-E, unlike several of AMD's mid-range GPUs.

Needless to say, the R9 290 has ample power for 1080p gaming. In Alien: Isolation, its minimum romped to 92fps, and it wasn't far off the golden 60fps target in Battlefield 4, Crysis 3 and Shadow of Mordor, where it managed smooth minimums of at least 50fps. The R9 290 can handle itself at 2,560 x 1,440 too. In Alien: Isolation, its minimum broke the 60fps barrier, and it was easily beyond 30fps in our other three games, so it will happily play every top title smoothly at 2,560 x 1,440 with maximum settings.

The R9 290 couldn't quite handle 4K in every game, although it was quicker than the GTX 970 at this resolution. It broke through the 30fps barrier in Alien and Shadow of Mordor, but only just squeezed past 25fps in Battlefield 4, and was far slower in Crysis 3.

We've tested the R9 290 at its stock speeds, but the card we used is a partner board that we've had to downclock. As such, while our performance figures are accurate, the power consumption results may be skewed. Even so, though, our test system's peak power draw of 368W with the R9 290 installed is very high, and Nvidia's GeForce GTX 970 undoubtedly has the upper hand in

Even the high-end GTX 980 drew just 295W from the mains at peak load.

Conclusion

AMD's recent price drops have seen cards such as the 280X come to prominence. The standard R9 280 remains our top affordable 1080p choice, but the R9 280X is still a good option if you want a tad more power – it's a little more expensive, but it can handle most games at 2,560 x 1,440. The higher price isn't the only potential downside, though, as the older hardware means there's no support for TrueAudio or FreeSync, and it's very power-hungry too. Otherwise, the 280X is a decent mid-range gaming card. **MJ**

1920 SPEED	2560 SPEED	3840 SPEED
20/25	10/15	2/10

VALUE	EFFICIENCY
37/40	5/10

VERDICT

Older, power-hungry hardware, but it can cope with most games at 2,560 x 1,440.

OVERALL SCORE **74%**

this area. There's another reason why we used a partner card for testing though: the AMD reference cooler is hot and noisy – a card with a third-party cooler will be much better. As such, we've based this review on the price of an XFX card with a third-party cooler

Conclusion

The R9 290's significant price drop helps it to compete with the GeForce GTX 970, which costs around £21 more, but isn't quite as quick at 4K. If you want a card with near-flawless 1080p performance and plenty of 2,560 x 1,440 power, the Radeon R9 290 now offers the best bang per buck. **MJ**

1920 SPEED	2560 SPEED	3840 SPEED
20/25	13/15	6/10

VALUE	EFFICIENCY
36/40	5/10

VERDICT

Cheaper and faster than the GTX 970 at 2,560 x 1,440, although power consumption is high.

OVERALL SCORE **80%**

Nvidia GeForce GTX 970 4GB / £250 inc VAT

SUPPLIER www.dabs.com

The GTX 970 has been one of the best graphics launches in recent years, thanks to its superb performance and a surprisingly aggressive price, but Nvidia's £250 card is now stacked up against AMD's R9 290 and 290X thanks to the red team's recent price cuts. Nvidia has made minor changes to the GTX 980's Maxwell core in order to create this more affordable GPU. Three of the 16 streaming multiprocessors have been disabled, which leaves the card with 1,664 stream processors.

Clock speeds have been cut back too. The GTX 980's 1,126MHz base clock has been lowered to 1,050MHz on the GTX 970, with that figure able to boost to 1,178MHz. The memory remains theoretically identical to the GTX 980, with 4GB of GDDR5 clocked to 7GHz (effective).

This card's specifications have also been undermined by recent controversies. Nvidia initially said the GTX 970 had 64 ROPs and 2MB of L2 cache, but it was caught out when cards were discovered to have 56 ROPs and 1.75MB of cache. Plus, while GTX 970 cards do have 4GB of memory, 0.5GB is partitioned into a slower section, so games only have access to 3.5GB of RAM. These are both disappointing issues, but we're concentrating on performance.

In terms of both price and performance, the GTX 970 is sandwiched between the two AMD R9 290 cards. The GTX 970 didn't struggle with any game at 1080p, but it only broke the 60fps barrier in Alien: Isolation – in our other three titles, it ranged between 56fps and 58fps.

The GTX 970 card returned playable figures in every one of our 2,560 x 1,440 game tests too, with a 63fps minimum in Alien and results above 30fps in every other game. It doesn't quite have the grunt for 4K gaming though. Its minimum managed to get beyond 30fps in Alien: Isolation and above our borderline playable 25fps target in Shadow of Mordor, but it fell behind in Battlefield 4 and Crysis 3. Both the Radeon R9 290 and 290X proved better at this resolution, with the R9 290 and 290X squeezing past 30fps in two games. Where the GTX 970 beats the competition is with its efficiency, with our test system drawing a peak of just 290W with the GTX 970 installed – 78W less than with the R9 290.

Conclusion

The GTX 970 has taken home awards in the past, but it's now hampered by AMD's price cuts. Its efficiency is great if you want a powerful card that's small and quiet, but the AMD chips now offer better bang per buck in terms of gaming performance. **MJ**

1920 SPEED	2560 SPEED	3840 SPEED
20/25	13/15	4/10

VALUE	EFFICIENCY
30/40	9/10

VERDICT

Great efficiency, but the Radeon R9 290 and 290X now offer more bang per buck.

OVERALL SCORE **76%**

Dual-GPU systems

One GPU doesn't quite cut it for every game at 4K, so which dual-GPU system will give you what you need? We turn to our benchmarks to find out

Nvidia and AMD have provided us with a slew of impressive high-end GPUs, but even the mighty GTX 980 struggles with today's ultimate gaming resolution: 4K. In our Crysis 3 test, the GTX 980 could only manage a minimum of 20fps – well below our playable milestone.

To get smooth gameplay at such a high resolution, you'll have to combine cards. Our previous tests revealed that two Radeon R9 290s hit the 4K sweet spot in terms of bang per buck (see Issue 135, p92), so this month we decided to stack these cards up against their nearest Nvidia equivalent – the GTX 970.

The two R9 290s proved more adept than the Nvidia hardware in Alien: Isolation. In this test, the AMD cards hit a minimum of 64fps – miles ahead of the two GTX 970s, which topped out at a still-playable 38fps. The gap was closer in average frame rates, though, where the R9 290's 79fps was only 8fps in front of Nvidia's hardware– both great results. AMD won in Battlefield 4 too. The R9 290s hit a minimum of 53fps, which is 10fps beyond Nvidia's dual-GPU minimum, although again both results are good.

The tide turned in Crysis 3 and Shadow of Mordor, though, with the pair of GTX 970s never dropping below 32fps in Crysis 3, while the two R9 290s could only maintain 28fps – a result that's still playable, but below the ideal 30fps figure.

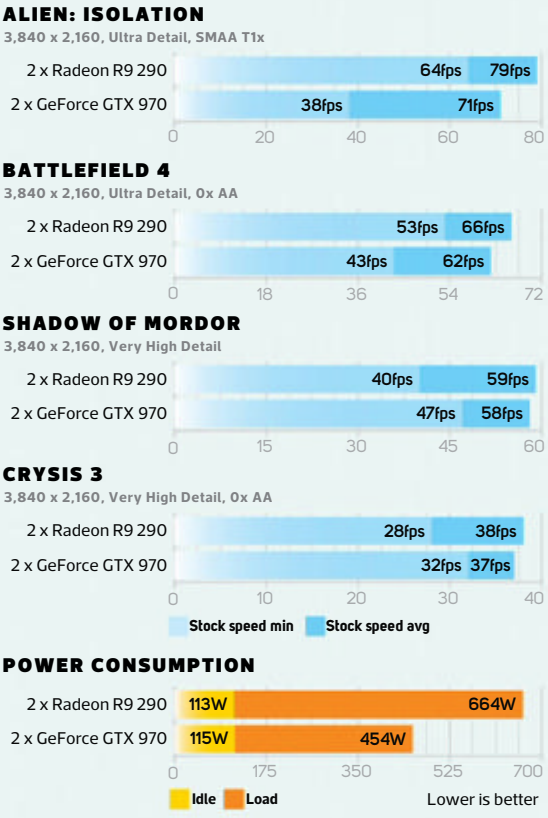
Importantly, Nvidia also claimed a massive victory in our power consumption tests, which is much more significant when you're running multiple GPUs. Running two cards is never going to impact well on the electricity bill, but our test system consumed just 454W with the two GTX 970s at peak load – much less than the AMD rig's 664W power draw. That bodes well for saving money, and you'll also have to deal with less heat output.

These dual-card setups both compare well with AMD's R9 295X2 too, which has two GPUs on the same PCB. Again, the dual GTX 970 setup was faster in two tests, and its power consumption was much lower, with our test system peaking at a massive 678W with the Radeon R9 295X2 installed. Both multi-card systems are cheaper than the 295X2 as well – the R9 295X2 costs £600, but pairs of AMD R9 290 and GTX 970 cards cost £450 and £500 respectively.

2 x Radeon R9 290

2 x GeForce GTX 970

You'll save cash when buying two separate cards, but installing a pair of high-end GPUs also comes with its own challenges, not least occasional glitches and waiting for driver updates. You'll also need to ensure your PSU has enough power connectors to hook up both cards, and to make sure your case has enough room to provide decent airflow, as two cards can be tricky to cool.



ELITE
NEW ENTRY
P62

AMD Radeon R9 290X 4GB / £274 inc VAT

SUPPLIER www.ebuyer.com

The R9 290X is AMD's single-GPU flagship, so it's the best example of the firm's Hawaii GPU. This architecture is built on a 28nm manufacturing process, and relies on the Graphics Core Next design. The R9 290X organises its 2,816 stream processors into 44 compute units, which are then divided into four shader engines. Each of those engines has its own geometry processor and rasteriser, and 64 ROPs are spread across the card.

The R9 290X has eight 64-bit memory controllers, making for a mighty 512-bit wide memory interface – wider than the 384-bit interface on Nvidia's top hardware. There's 4GB of 5GHz (effective) GDDR5 memory too, making for a total bandwidth figure of 320GB/sec, trumping the 224GB/sec bandwidth from the 4GB of memory soldered on Nvidia's GeForce GTX 680.

AMD's flagship also supports the company's new TrueAudio and Mantle tech, along with FreeSync. And, if you want to install multiple cards, you won't need a CrossFire bridge, as the R9 290X handles CrossFire over the PCI-E bus instead. The R9 290X is a high-end and very hot-running chip, though, so you won't find any semi-passive or small form factor designs – an R9 290X card will take up plenty of space in most enclosures. It also has demanding power requirements, with single 6-pin and 8-pin connectors at the back of the PCB.

Not surprisingly, the R9 290X didn't have any issues with our 1080p tests. In Alien: Isolation, its minimum rose to a cool 100fps, and in Battlefield 4 and Shadow of Mordor, its minimum went beyond 60fps – the ideal figure to guarantee perfectly smooth gameplay. It didn't quite hit this target in Crysis 3, but its minimum of 53fps in this test is still excellent.

The R9 290X didn't have any problems at 2,560 x 1,440 either. It beat the 60fps barrier again in Alien: Isolation, and never dropped below 40fps in Battlefield 4 and Shadow of Mordor. Crysis 3 remained the Radeon's biggest challenge, but it recorded a minimum of 35fps, which is still ample pace for smooth play.

It impressed in some of our 4K tests too. At 3,840 x 2,160, it hit a minimum of 35fps in Alien and Shadow of Mordor – enough to ensure smooth gameplay in both games. In Battlefield, it hit 29fps, which is just in front of our 25fps bare minimum for playable gameplay. It only faltered in Crysis 3, where the frame rate dropped down to 17fps.

As with the Radeon R9 290, the AMD reference cooler for the R9 290X is abysmal, making lots of noise and sometimes getting so hot that the core clock throttles. As such, we tested a Sapphire Vapor-X version, but ran it at stock speeds. Our use of partner cards means power consumption can vary, but Sapphire's card deserves praise, as it consumed less power than our R9 290, with our system consuming 335W at peak load. Not all 290X cards will be as efficient, though, and the Sapphire card isn't cheap, so we've based our review on the price of a PowerColor card with a third-party cooler, and the usual higher power draw we've seen from other Radeon 290X cards.

Conclusion

Avoid the reference cooler, and you're onto a winner with the R9 290X. It swats aside our 1080p and 2,560 x 1,440 tests, and even has the power to handle most games at 4K – only in Crysis 3 did it fall short. It's almost as fast as Nvidia's GTX 980, despite costing almost £150 less, offering a great balance of power and performance. **MJ**

1920 SPEED	2560 SPEED	3840 SPEED
23/25	13/15	6/10

VALUE	EFFICIENCY
32/40	5/10

VERDICT

Ample power at all resolutions, and for much less money than the GeForce GTX 980.

OVERALL SCORE 79%

Nvidia GeForce GTX 980 4GB / £420 inc VAT

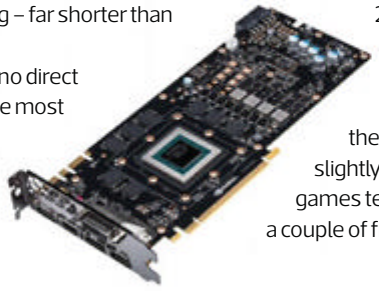
SUPPLIER www.scan.co.uk

Nvidia's most expensive single-GPU card represents the pinnacle of the Maxwell architecture. The new GPU core is designed to do more with less – its stream processors have been reorganised into smaller blocks, and improved task management means that the GPU's resources are better distributed between its various tasks.

The Maxwell architecture is not only designed to save power, but also built to blast through games. The GTX 980 has 2,048 stream processors arranged in 16 streaming multiprocessors (SMs), with four of those SMs inside a quartet of graphics processing clusters. The GPU core is clocked to a lofty 1,126MHz, and it can dynamically boost to 1,216MHz.

There's also 4GB of GDDR5 memory clocked to 7GHz (effective), but it's only accessed using a 256-bit interface - half the width of the bus on AMD's Radeon R9 290X. Maxwell's efficiency improvements mean the GTX 980 is a surprisingly modest flagship when it comes to power requirements and PCB real estate too – it only requires two 6-pin PCI-E power connectors, and its stock PCB design is 267mm long – far shorter than top-end AMD hardware.

This high-end card has no direct rival in the AMD camp – the most powerful single-GPU Radeon, the R9 290X, costs a comparatively modest £264, and the dual-GPU R9 295X2 is more powerful and costs a stratospheric £600.



Not surprisingly, the GTX 980 didn't struggle with 1080p tests. It blasted through our ideal 60fps barrier in every game, and in Alien: Isolation, it topped 115fps, which was the best score recorded from any single-GPU card in this Labs.

The Nvidia hardware continued to impress when we upped the resolution. At 2,560 x 1,440, the GTX 980 remained above 60fps in Alien: Isolation, and in the rest of our tests the 980 topped 40fps, never dropping below 50fps in Shadow of Mordor. At this higher resolution, all games are clearly playable, but the R9 290X remained only a few frames per second behind.

The GTX 980 proved decent at 4K resolution too. Its Alien and Shadow of Mordor results remained above 30fps, which is our milestone for smooth gameplay, and in Battlefield 4, it managed 28fps, which is 3fps above what we consider to be borderline playable. Only in Crysis 3 did the GTX 980 fail to hit our targets.

Again, though, the price difference between the GTX 980 and the R9 290X wasn't highlighted in benchmarks. The Nvidia card was faster in Alien: Isolation and Crysis 3, with the AMD hardware being slightly quicker in our other two games tests. There are only gaps of a couple of frames per second between the two GPUs, though, and you expect more of a gulf when the GTX 980 is so much pricier.

The Maxwell architecture remains far more efficient than AMD's equivalent, of course. Our system's power consumption of 295W with the GTX 980 installed is lower than that of the R9 280X, the R9 290 and the R9 290X, all of which caused our system to draw more than 300W from the mains.

Conclusion

The GTX 980 is the fastest single-GPU card you can buy, and that fact alone makes it a must-have for some people, and it's very efficient too. When it comes to the all-important bang per buck, though, it isn't so impressive. After AMD's price cuts, the performance gap between the GTX 980 and the R9 290X isn't enough to justify the Nvidia card's far higher price. Unless you crave the market's fastest GPU, the R9 290X is a better-balanced high-end option. **MJ**

1920 SPEED	2560 SPEED	3840 SPEED
25/25	13/15	6/10

VALUE	EFFICIENCY
22/40	10/10

VERDICT

The fastest single-GPU card, and it's efficient too, but it's only slightly quicker than the R9 290X.

OVERALL SCORE 76%

AMD Radeon R9 295X2 8GB / £600 inc VAT

SUPPLIER www.scan.co.uk

AMD's most expensive card weighs in at a mighty £600, but that amount looks cheap compared to its debut price – back when the R9 295X2 first appeared, variants could often be found for more than £1,000. That's a big drop, but there's a good reason why the R9 295X2 still costs so much. It's the only card in this month's test with two GPUs, so it offers the only way to get dual graphics power while using one PCI-E slot.

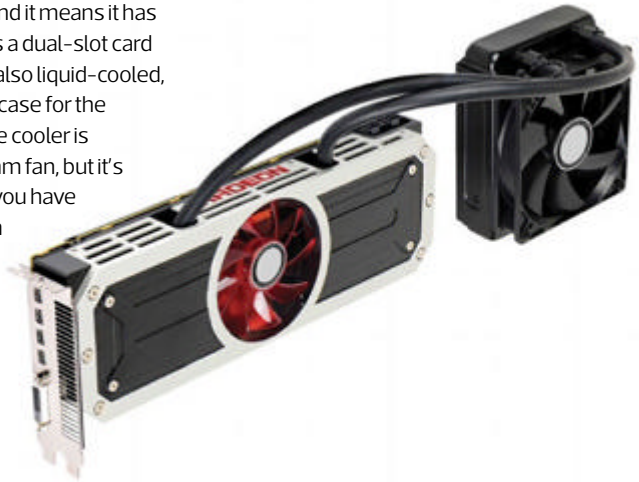
The R9 295X2 is built using two of AMD's full-fat Hawaii GPUs – in effect, it's two R9 290X cards on one PCB. Each GPU has the full complement of 44 compute units with 2,816 stream processors, and the GPUs are clocked to 1,018MHz – a little higher than the 1GHz speed of the standard R9 290X. There's been no compromise on the memory front either. Each GPU has 4GB of GDDR5 clocked to 5GHz (effective), and they're both accessed using a 512-bit interface.

All of the above makes this GPU overkill for 1080p and 2,560 x 1,440, and it means it has hefty physical demands. It's a dual-slot card that's 307mm long, but it's also liquid-cooled, so you'll need room in your case for the 120mm Asetek radiator. The cooler is supplied with a single 120mm fan, but it's easy to add a second fan if you have room. You'll need two 8-pin PCI-E power connectors on your PSU, and each connector must hook up to a separate +12V rail.

It's no surprise that this card stomped all over our benchmarks. In every 1080p test, its minimum frame rate stormed beyond 60fps, with three-figure scores in Alien: Isolation and Battlefield 4, and it was similarly impressive at 2,560 x 1,440 – it even managed to beat our ideal 60fps minimum figure in Crysis 3, and it was only 4fps shy of that tough target in Shadow of Mordor.

Clearly, this card is designed for 4K gaming, and it delivered in this area too. Its minimum topped 60fps in Alien, beat 50fps in Battlefield and 40fps in Shadow of Mordor. In Crysis 3 the R9 295X2 could only manage a minimum of 29fps, but that's still 4fps ahead of the minimum we consider for playable gameplay.

The R9 295X2's results are far beyond those of any single-GPU card, but it struggles to justify its cost compared to dual-card setups. In our recent tests (see p50), a pair of GTX 970 cards costs £100 less but results in quicker performance, never dipping below 30fps in Crysis 3.



Also, while the R9 295X2 is a benchmark-breaking card, it comes with similarly lofty power requirements. With the 295X2 installed, our test system's idle power draw of 133W was higher than with any other card in the Labs, and it topped out at 678W at peak load – more than 300W higher than with a single R9 290 card installed.

Conclusion

The Radeon R9 295X2 is a hugely expensive card, but it still delivers an awful lot of gaming performance. Its two R9 290X GPUs battered our 2,560 x 1,440 benchmarks, and proved adept at 4K too. There's no denying the R9 295X2's gaming ability; if you want to play top titles at 4K without having two cards inside your PC, perhaps in a souped-up mini-ITX rig (providing there's room in the chassis), it's the best option available. For everyone else, however, a pair of GeForce GTX 970 cards, or even Radeon R9 290 cards, offers a better bang per buck ratio, without the need to find space for a liquid-cooling unit. **MJ**

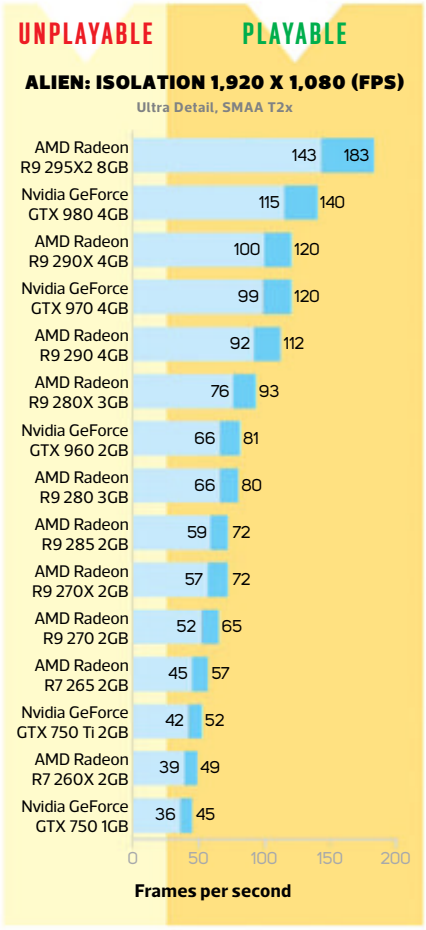
1920 SPEED	2560 SPEED	3840 SPEED
25/25	15/15	10/10

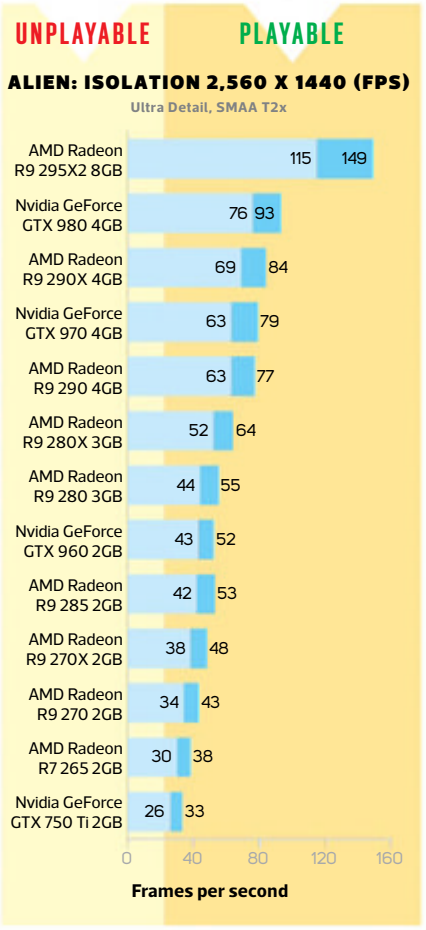
VALUE	EFFICIENCY
17/40	6/10

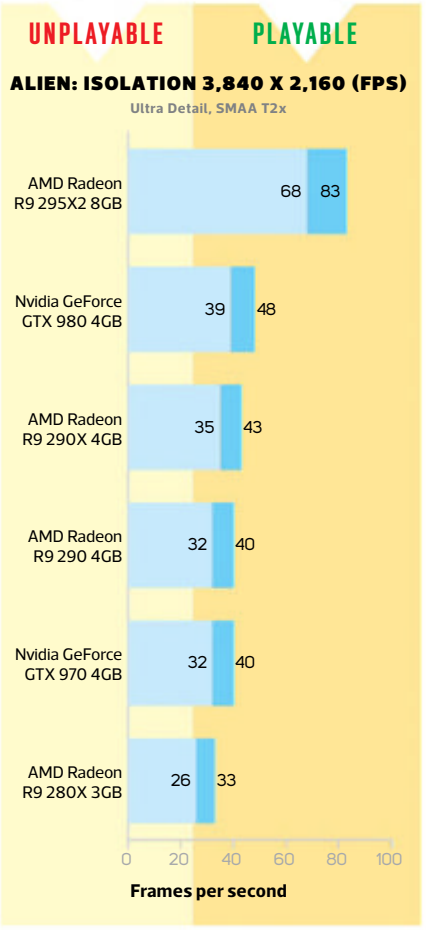
VERDICT

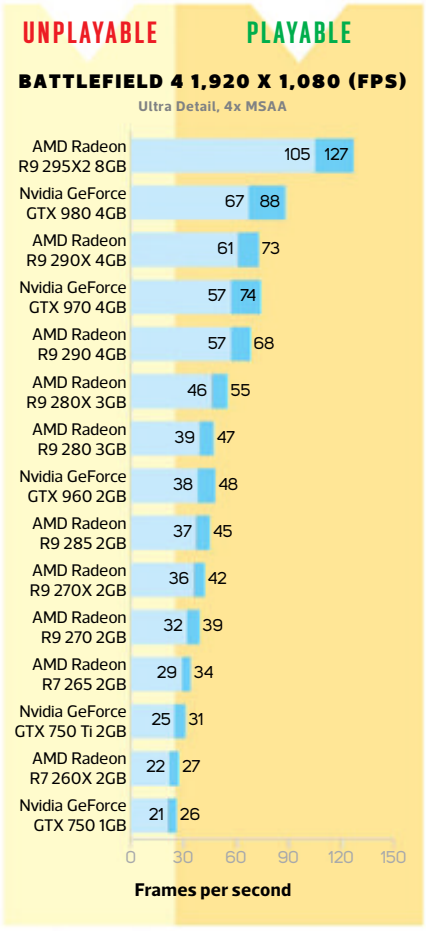
The only card to handle every game at 4K, but a pair of GTX 970s offers much better value.

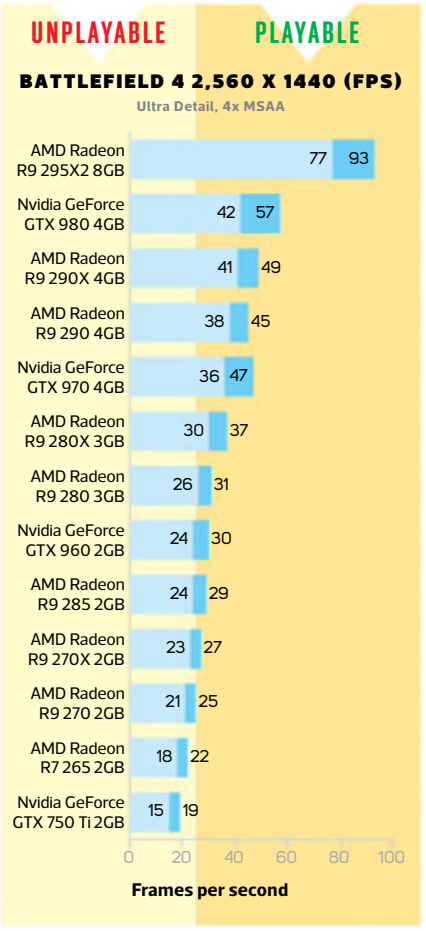
OVERALL SCORE 73%

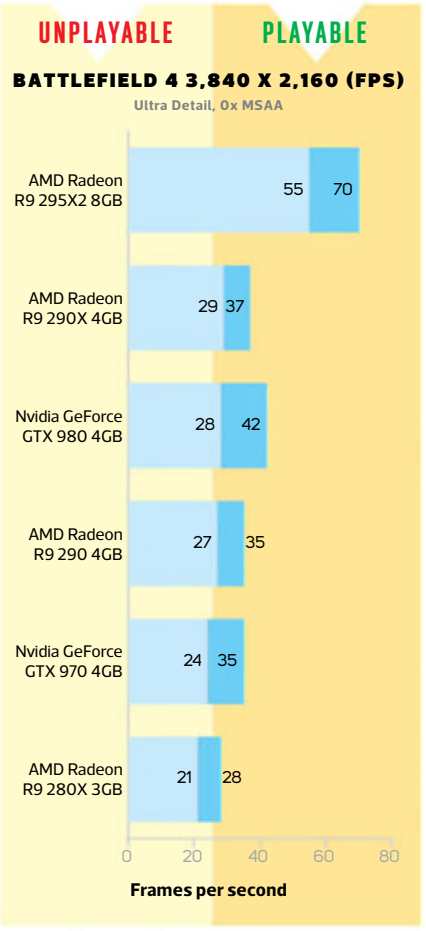

UNPLAYABLE
PLAYABLE
ALIEN: ISOLATION 1,920 X 1,080 (FPS)
Ultra Detail, SMAA T2x
AMD Radeon R9 295X2 8GB 143 183
Nvidia GeForce GTX 980 4GB 115 140
AMD Radeon R9 290X 4GB 100 120
Nvidia GeForce GTX 970 4GB 99 120
AMD Radeon R9 290 4GB 92 112
AMD Radeon R9 280X 3GB 76 93
Nvidia GeForce GTX 960 2GB 66 81
AMD Radeon R9 280 3GB 66 80
AMD Radeon R9 285 2GB 59 72
AMD Radeon R9 270X 2GB 57 72
AMD Radeon R9 270 2GB 52 65
AMD Radeon R7 265 2GB 45 57
Nvidia GeForce GTX 750 Ti 2GB 42 52
AMD Radeon R7 260X 2GB 39 49
Nvidia GeForce GTX 750 1GB 36 45
0 50 100 150 200
Frames per second


UNPLAYABLE
PLAYABLE
ALIEN: ISOLATION 2,560 X 1440 (FPS)
Ultra Detail, SMAA T2x
AMD Radeon R9 295X2 8GB 115 149
Nvidia GeForce GTX 980 4GB 76 93
AMD Radeon R9 290X 4GB 69 84
Nvidia GeForce GTX 970 4GB 63 79
AMD Radeon R9 290 4GB 63 77
AMD Radeon R9 280X 3GB 52 64
AMD Radeon R9 280 3GB 44 55
Nvidia GeForce GTX 960 2GB 43 52
AMD Radeon R9 285 2GB 42 53
AMD Radeon R9 270X 2GB 38 48
AMD Radeon R9 270 2GB 34 43
AMD Radeon R7 265 2GB 30 38
Nvidia GeForce GTX 750 Ti 2GB 26 33
0 40 80 120 160
Frames per second


UNPLAYABLE
PLAYABLE
ALIEN: ISOLATION 3,840 X 2,160 (FPS)
Ultra Detail, SMAA T2x
AMD Radeon R9 295X2 8GB 68 83
Nvidia GeForce GTX 980 4GB 39 48
AMD Radeon R9 290X 4GB 35 43
AMD Radeon R9 290 4GB 32 40
Nvidia GeForce GTX 970 4GB 32 40
AMD Radeon R9 280X 3GB 26 33
0 20 40 60 80 100
Frames per second


UNPLAYABLE
PLAYABLE
BATTLEFIELD 4 1,920 X 1,080 (FPS)
Ultra Detail, 4x MSAA
AMD Radeon R9 295X2 8GB 105 127
Nvidia GeForce GTX 980 4GB 67 88
AMD Radeon R9 290X 4GB 61 73
Nvidia GeForce GTX 970 4GB 57 74
AMD Radeon R9 290 4GB 57 68
AMD Radeon R9 280X 3GB 46 55
AMD Radeon R9 280 3GB 39 47
Nvidia GeForce GTX 960 2GB 38 48
AMD Radeon R9 285 2GB 37 45
AMD Radeon R9 270X 2GB 36 42
AMD Radeon R9 270 2GB 32 39
AMD Radeon R7 265 2GB 29 34
Nvidia GeForce GTX 750 Ti 2GB 25 31
AMD Radeon R7 260X 2GB 22 27
Nvidia GeForce GTX 750 1GB 21 26
0 30 60 90 120 150
Frames per second

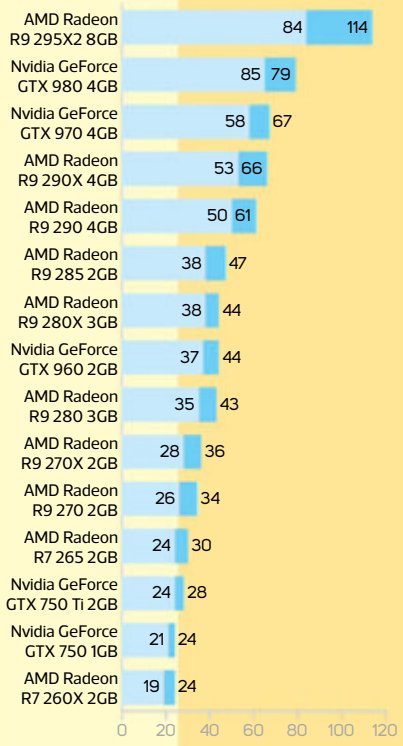

UNPLAYABLE
PLAYABLE
BATTLEFIELD 4 2,560 X 1440 (FPS)
Ultra Detail, 4x MSAA
AMD Radeon R9 295X2 8GB 77 93
Nvidia GeForce GTX 980 4GB 42 57
AMD Radeon R9 290X 4GB 41 49
AMD Radeon R9 290 4GB 38 45
Nvidia GeForce GTX 970 4GB 36 47
AMD Radeon R9 280X 3GB 30 37
AMD Radeon R9 280 3GB 26 31
Nvidia GeForce GTX 960 2GB 24 30
AMD Radeon R9 285 2GB 24 29
AMD Radeon R9 270X 2GB 23 27
AMD Radeon R9 270 2GB 21 25
AMD Radeon R7 265 2GB 18 22
Nvidia GeForce GTX 750 Ti 2GB 15 19
0 20 40 60 80 100
Frames per second


UNPLAYABLE
PLAYABLE
BATTLEFIELD 4 3,840 X 2,160 (FPS)
Ultra Detail, 0x MSAA
AMD Radeon R9 295X2 8GB 55 70
AMD Radeon R9 290X 4GB 29 37
Nvidia GeForce GTX 980 4GB 28 42
AMD Radeon R9 290 4GB 27 35
Nvidia GeForce GTX 970 4GB 24 35
AMD Radeon R9 280X 3GB 21 28
0 20 40 60 80
Frames per second

UNPLAYABLE PLAYABLE

CRYSIS 3 1,920 X 1,080 (FPS)

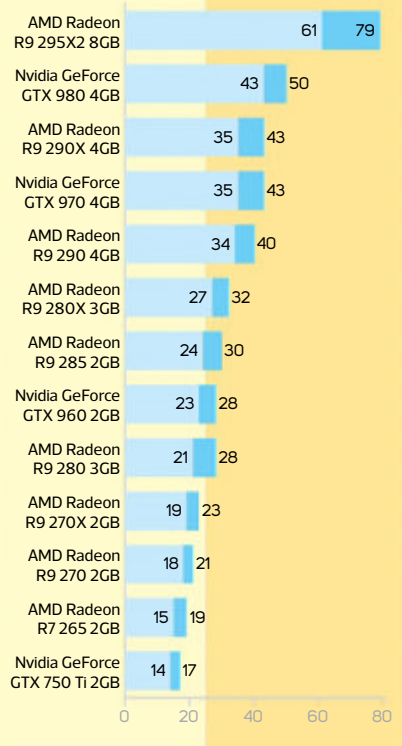
Very High Detail, 0x AA



UNPLAYABLE PLAYABLE

CRYSIS 3 2,560 X 1440 (FPS)

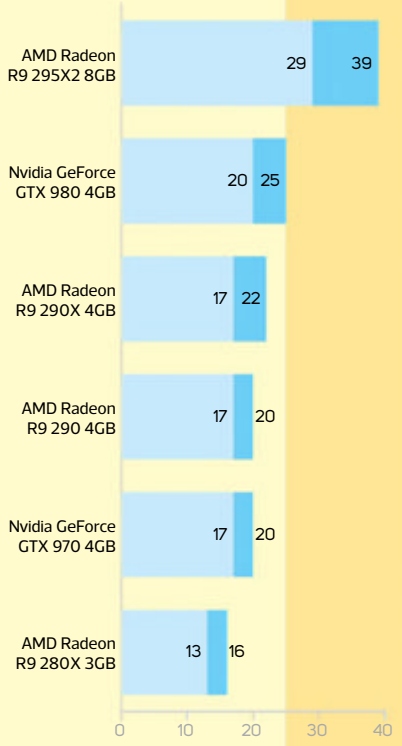
Very High Detail, 0x AA



UNPLAYABLE PLAYABLE

CRYSIS 3 3,840 X 2,160 (FPS)

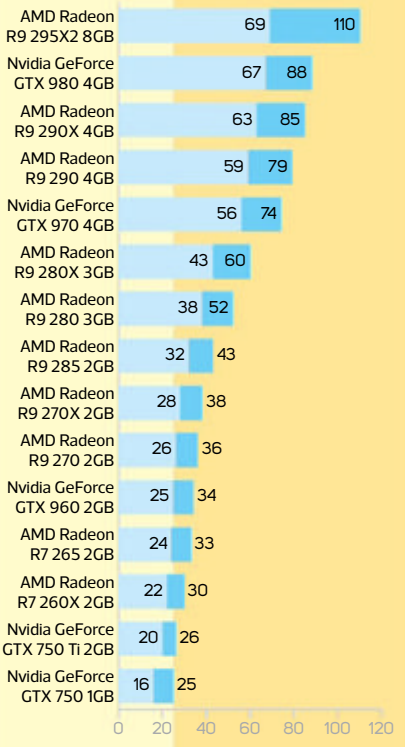
Very High Detail, 0x AA



UNPLAYABLE PLAYABLE

SHADOW OF MORDOR 1,920 X 1,080 (FPS)

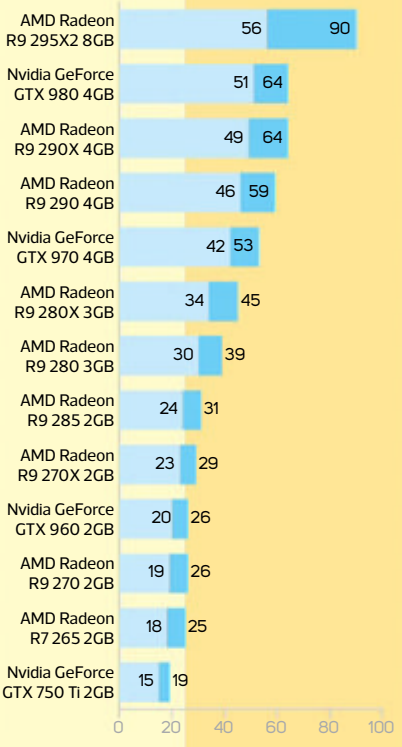
Ultra Detail



UNPLAYABLE PLAYABLE

SHADOW OF MORDOR 2,560 X 1440 (FPS)

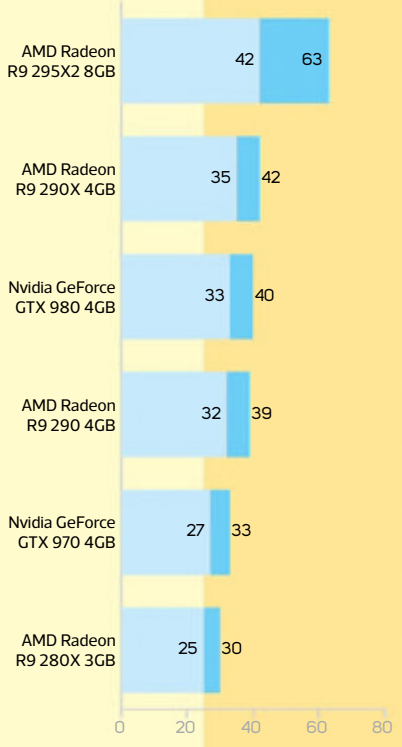
Ultra Detail



UNPLAYABLE PLAYABLE

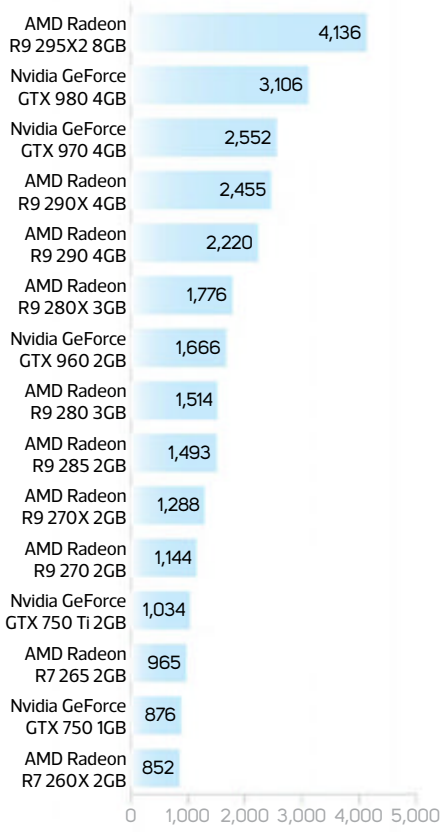
SHADOW OF MORDOR 3,840 X 2,160 (FPS)

Very High Detail



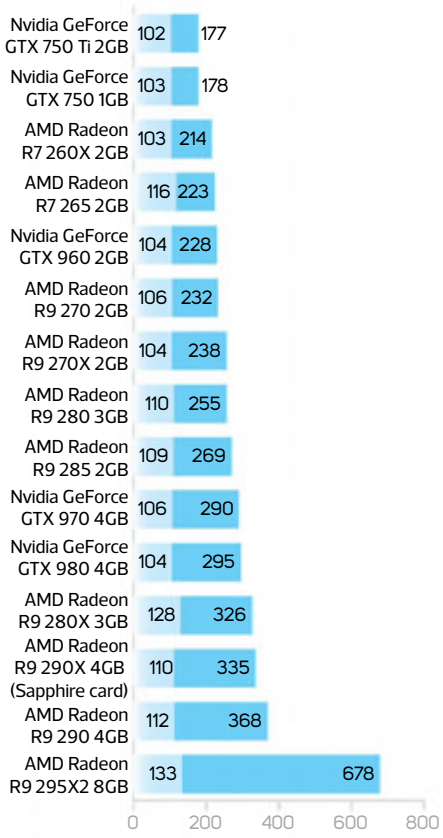
UNIGINE VALLEY

2,560 x 1,440, Ultra Detail, 0x AA



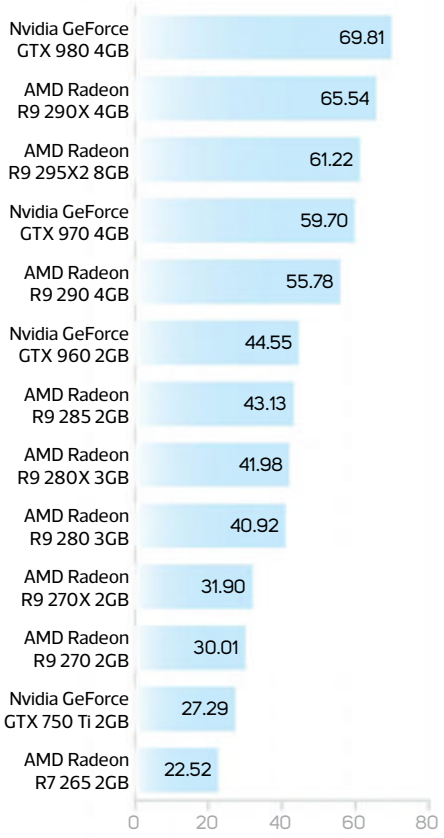
POWER CONSUMPTION (WATTS)

Total system – Windows Desktop / Unigine Valley



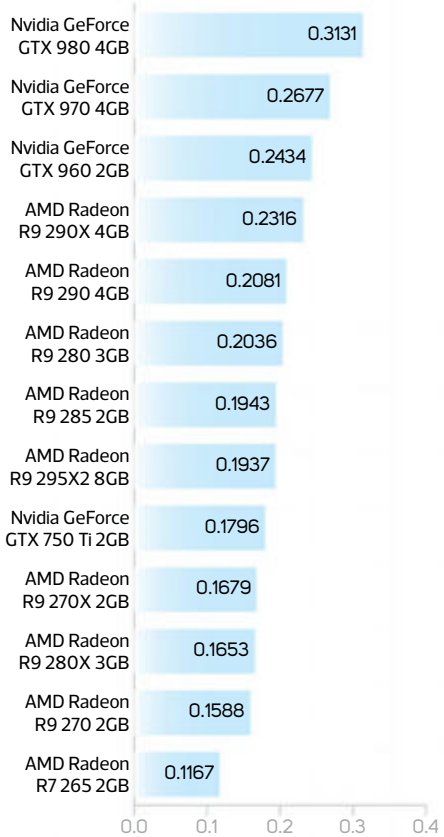
FOLDING@HOME

FAH Bench, Explicit Solvent, FP32



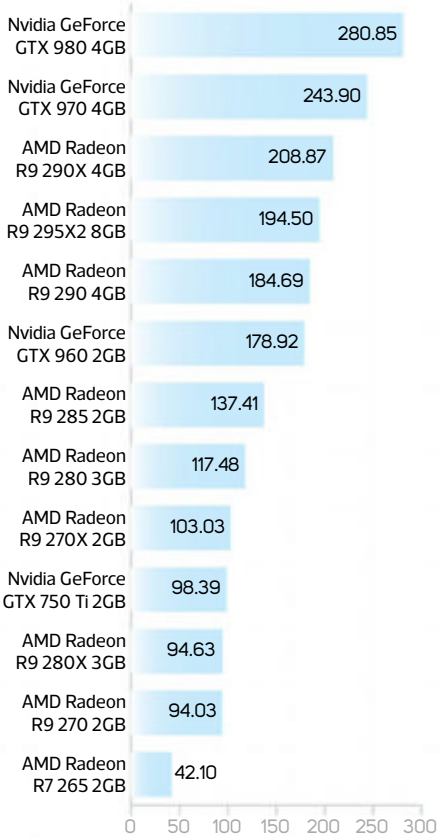
FOLDING@HOME EFFICIENCY

Explicit Solvent



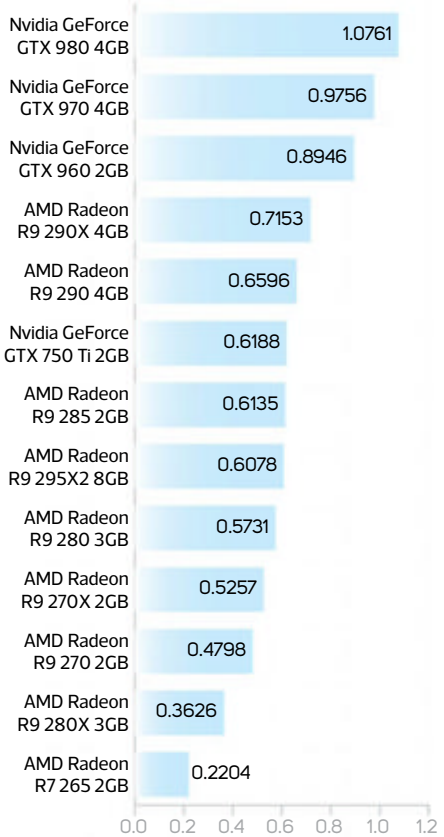
FOLDING@HOME

FAH Bench, Implicit Solvent, FP32



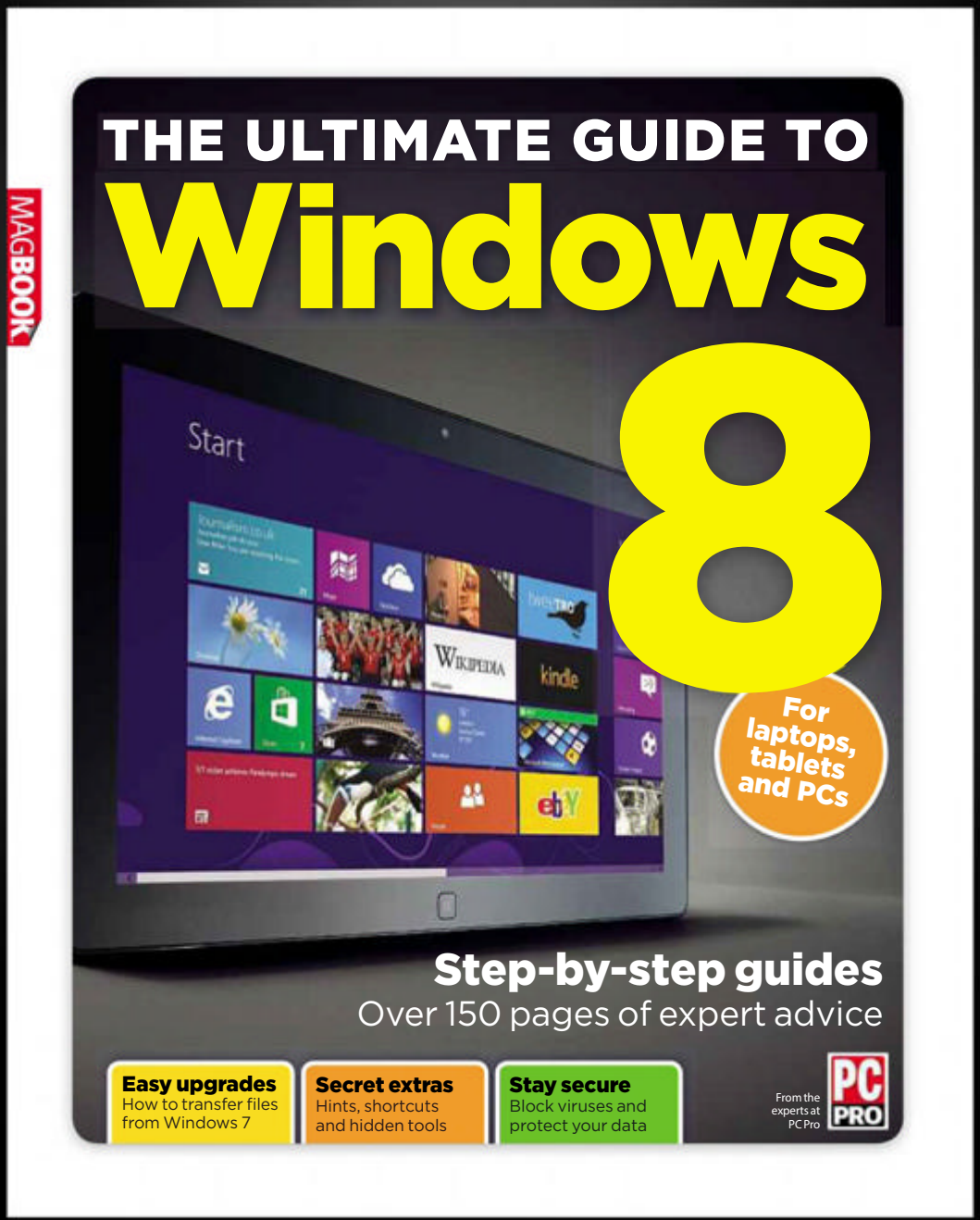
FOLDING@HOME EFFICIENCY

Implicit Solvent



Everything you'll ever need to know about **Windows 8**

MAGBOOK



ON SALE NOW

Order your print or digital copy direct from **magbooks.com** or call on **0844 844 0053**

Magbooks cover a range of topics from IT, Motoring to Fitness and Lifestyle

ONLY £7.99

Mid-range gaming PCs

Box Cube Blizzard

£1,099 inc VAT

SUPPLIER www.box.co.uk

Cyberpower Infinity Achilles XT

£999 inc VAT

SUPPLIER www.cyberpowersystem.co.uk

Following the recent launch of Nvidia's GeForce GTX 960, we invited Box and Cyberpower into **Custom PC** with their latest mid-range gaming systems. In the Labs this month, we found that AMD's recent aggressive price cuts have made life tough for the GeForce GTX 960 as an individual upgrade at retail cost, since AMD's Radeon R9 280 offers more in terms of bang per buck.

However, the GTX 960 is still a very power-efficient card with formidable 1080p gaming performance, so it still makes sense to use one in a pre-built, mid-range gaming rig, where the manufacturer gets the benefit of cost pricing.

Both firms have supplied traditional tower systems, with prices only £100 apart, but there's plenty to separate the Box Cube Blizzard and Cyberpower Infinity Achilles XT.

The components

The Box machine is pricier, and it's immediately more striking. Its Fractal Design Define R4 case is bright white, and the interior is dominated by a monochromatic theme. The MSI motherboard is black with white heatsinks, the Kingston HyperX Fury RAM is topped with white metal, and the fan on the black NZXT CPU cooler stands out with its white fins.

That isn't the end of the two-tone colour scheme either. The MSI graphics card has a black and white heatsink, and the modular Super Flower PSU has black cables at the bottom, but white individually threaded cables are used to power the motherboard and the graphics card. Cable routing is top-notch elsewhere too. The Fractal's interior metal is white as well, and its white hard disk cage is loaded with a bevy of black metal storage trays.

Those hard disk bays are side-facing, and the metal trays are stronger than the plastic versions inside Cyberpower's case. They aren't tool-free, but they have rubber washers, and there's plenty of them – because the storage cage hasn't been removed, the Box machine has room for six extra drives too.

The whole lot is illuminated by a white light that runs along the bottom of the case. The Box machine looks fantastic, and Fractal's case excels in practical aspects too; it's very quiet, and the door, side panel and roof all house sound-absorbing material.

The Box system also has plenty of room for additional components elsewhere. Two free DIMM slots can be used to add more memory, and there's a full-sized M.2 socket in the middle of the motherboard. A single 1x PCI-E slot lies above the graphics card, with another below, and the board also offers two PCI slots and a second 16x PCI-E slot. If both 16x PCI-E slots are used, they'll run at 8x speed.

The Blizzard makes a great first impression, and Box has deployed a beefed-up graphics card too. The MSI-made GeForce GTX 960 has seen its stock speed of 1,127MHz raised to 1,178MHz and its boost speed jump from 1,228MHz to 1,241MHz. The GPU is underpinned by Intel's Core i5-4690K. It's one of the firm's latest unlocked Devil's Canyon chips, and has been overclocked from 3.5GHz to 4.6GHz, thanks to a multiplier of 100x and a vcore of 1.27V. It's paired with 8GB of 1,866MHz memory.

The storage situation isn't as impressive though. Windows 8.1 is loaded onto an unremarkable 120GB Kingston HyperX 3K SSD, and the Seagate hybrid hard disk offers the same 2TB capacity as the drive inside the Cyberpower, albeit with solid state hybrid caching.

Cyberpower's PC isn't as striking, but there's no denying the power available. Its Core i7-4790K CPU is overclocked from 4GHz to 4.5GHz, which means it's 100MHz slower than the Box machine, but the Core i7 chip fights back with its support for Hyper-Threading and a larger L3 cache.

The 8GB of RAM is clocked to 2,133MHz – faster than the Box's memory, and there's a 128GB Samsung XP941 M.2 SSD. Elsewhere, there's a 2TB Seagate Barracuda hard disk, and Cyberpower's Gigabyte Z97X-SLI motherboard offers a similar feature set to the MSI hardware inside the Box system, as it's also able to handle two-way graphics setups.

The Infinity Achilles XT doesn't have the striking looks of the Cube Blizzard, but there's a definite theme at work and its brooding, matt material looks undeniably classy. The interior is black, but it's lit from below by a red strip light. The Gigabyte motherboard sports black and red heatsinks, and the memory is topped with red heatspreaders too.

Cyberpower's machine is built impeccably as well. The Corsair PSU isn't modular, but its cables are immaculately tied together and hidden behind the motherboard tray, and cables only pop up discreetly – the GPU power cable is tied in a straight line, and all the other wires emerge from rubber-ringed cable-routing holes. The connectors used for the headers at the bottom of the board are also routed beneath the PCB to keep them out of the way.

The careful cabling makes this an easy system to work inside, but it doesn't have as much room to grow as the Box PC. Cyberpower has removed the upper hard disk cage to improve airflow to the GPU, but that leaves only three free hard disk bays, and they use tool-free plastic caddies that aren't as sturdy as the metal units in the Cube Blizzard - in all likelihood, though, most people are very unlikely to need more than three hard drive bays. Meanwhile, the motherboard's top 1x PCI-E slot is already occupied by a wireless card, and the M.2 slot is already used by the SSD.

Box

1 **NZXT's excellent Kraken X41 helps to keep down the CPU temperature**

2 **The monochromatic colour scheme is illuminated with white light**

3 **There's plenty of room for extra hard drives in these solid trays**

BOX / SPECIFICATIONS

CPU 3.5GHz Intel Core i5-4690K overclocked to 4.6GHz

Motherboard MSI Z97S Krait Edition

Memory 8GB 1,866MHz Kingston HyperX Fury DDR3

Graphics MSI GeForce GTX 960 2GB

Sound On-board

Storage 120GB Kingston HyperX 3K SSD, 2TB Seagate hybrid hard disk, DVD writer

Case Fractal Design Define R4 White Edition

Cooling CPU: NZXT Kraken X41, 2 x 140mm fans; GPU: 2 x 100mm fans; Front: 1 x 140mm fan

PSU Super Flower Leadex 650W Gold

Ports Front: 2 x USB 3, 2 x USB 2, 2 x audio; rear: 4 x USB 3, 2 x USB 2, Gigabit Ethernet, 1 x PS/2, 6 x audio

Operating system Windows 8.1 64-bit

Warranty Two year parts and labour, one year collect and return and one year return to base

Beneath the graphics card lies a 16x PCI-E slot that runs at 8x speed if two cards are used, a vacant 1x PCI-E slot and two PCI slots, while two memory slots are free. The mid-range specification means that overly complex cooling isn't required. The overclocked CPU is chilled by a Corsair H55 with a single 120mm fan, and there are two 120mm spinners in the front, but that's it.

Performance

These machines may both include GTX 960 cards, but the overclocked version inside the Box system gave it the slight edge over the Cyberpower. The Box machine's 38fps minimum in Battlefield 4 at 1080p was 3fps quicker than its rival, although neither machine could achieve our bare minimum playable target of 25fps at 2,560 x 1,440.

Meanwhile, in BioShock Infinite, both titles went beyond 60fps, which is our target for silky-smooth gameplay, but the overclocked Box card's 66fps score was 3fps ahead of

Cyberpower

1 **A single-fan Corsair H55 sits on top of the overclocked Core i7 CPU**

2 **The middle drive cage has been removed to allow more airflow over the GPU**

3 **Cables are carefully tidied away in rubber-ringed routing holes**

CYBERPOWER / SPECIFICATIONS

CPU 4GHz Intel Core i7-4790K overclocked to 4.5GHz

Motherboard Gigabyte Z97X-SLI

Memory 8GB 2,133MHz Kingston HyperX Savage DDR3

Graphics MSI GeForce GTX 960 2GB

Sound On-board

Storage 128GB Samsung XP941 M.2 SSD, 2TB Seagate hard disk, DVD writer

Case Corsair Obsidian 450D

Cooling CPU: Corsair H55, 1 x 120mm fan; GPU: 1 x 70mm fan; front: 2 x 140mm

PSU Corsair VS450

Ports Front: 2 x USB 3, 2 x audio; rear: 4 x USB 3, 2 x USB 2, Gigabit Ethernet, 1 x PS/2, 6 x audio

Operating system Windows 8.1 64-bit

Warranty Three years labour, two years parts, return to base. One month collect and return

the Infinity system. Both machines remained playable when we loaded the game at 2,560 x 1,440 too, although the Box's 40fps minimum was slightly faster.

Crysis 3 is our toughest game, so it's no surprise that neither machine went beyond the ideal 30fps minimum – instead, they only went beyond the 25fps barrier that we take as the bare minimum for gameplay, with the Box machine 1fps ahead. Neither PC could manage to play this game at 2,560 x 1,440, with minimums in the high teens.

Cyberpower's Core i7 processor fought back in application benchmarks though. Its Hyper-Threading support saw it romp to 265,656 in our video encoding test – far better than the 230,933 recorded by the Cube Blizzard. This pattern was repeated in our heavy multi-tasking benchmark too, where it scored 160,947 – more than 30,000 points ahead of its rival. Not surprisingly, the Cyberpower's overall score of 125,126 trumped the 107,879 scored by the Blizzard. Bear in mind, though, that these results are only applicable to widely multi-threaded workloads – you won't see these performance differences in everyday apps or games.

The Cyberpower's M.2 SSD proved faster in benchmarks too. Its sequential read speed of 750MB/sec shattered the traditional SATA interface, and its write pace of 426MB/sec is decent too. Both of those results beat the SATA Kingston drive in the Box, which managed 494MB/sec and just 231MB/sec in the same benchmarks.

We weren't able to extract much more performance from either system with extra overclocks. The Box machine's Core i5 processor is already tweaked to 4.6GHz, but we couldn't get the CPU to hit 4.8GHz even with a hefty 1.35V blasted through the core – instead, we settled for a 4.7GHz revision with a vcore of 1.33V. The Cyberpower machine wasn't much better – we hit 4.8GHz with a 1.33V core, but that's only 300MHz faster than its already decent overclock.

Those tweaks delivered modest benchmark bumps. The Box's overall application score jumped to 111,435, and the Cyberpower's revised core saw its benchmark result improve to 131,892. In short, the manufacturers' CPU overclocks for these machines are already good – there's little need to push them further.

We tweaked the graphics cards too. The Box's GPU arrived overclocked, so we could only add 200MHz and 75MHz to its GPU and memory clocks, which meant revised speeds of 1,378MHz and 1,828MHz. The Cyberpower's clock and memory rose by 233MHz and 80MHz, which meant new speeds of 1,360MHz and 1,833MHz.

They're both decent improvements, but they only made small differences to our game tests. Both machines still handled our three test games at 1080p, but they weren't quite able to handle 2,560 x 1,440. In Battlefield 4 at the this resolution, both machines went past our 25fps minimum target, but only by 1fps, and in Crysis 3 they still couldn't get near that modest figure.

These mid-range machines didn't cause us any thermal headaches either. The Cyberpower's CPU delta T of 58°C was 4°C higher than in the Core i5-powered Box system (thanks to the Box's use of our Elite-listed NZXT X41 CPU cooler). The Cyberpower's GPU also proved toastier, with its delta T of 49°C being 5°C warmer than in the Cube Blizzard. Neither system is overly warm in either respect though.

Thanks to the GeForce GTX 960's efficiency, these mid-range rigs delivered modest power draws too. The Cyberpower required more grunt than the Box machine, with a peak stock draw of 271W compared to 249W from the Blizzard. Power wasn't much of an issue, and neither was noise – both machines churned out low rumbles, neither of which will be irritating in use.

Warranty

Box's machine offers two years return-to-base parts and labour coverage, with the first year also covered by a collect-and-return deal. Cyberpower's machine has its labour covered for the whole three-year period, and two years of parts coverage is also included, although there's only one month of collect-and-return service included. Both are good deals, but have respective pros and cons.

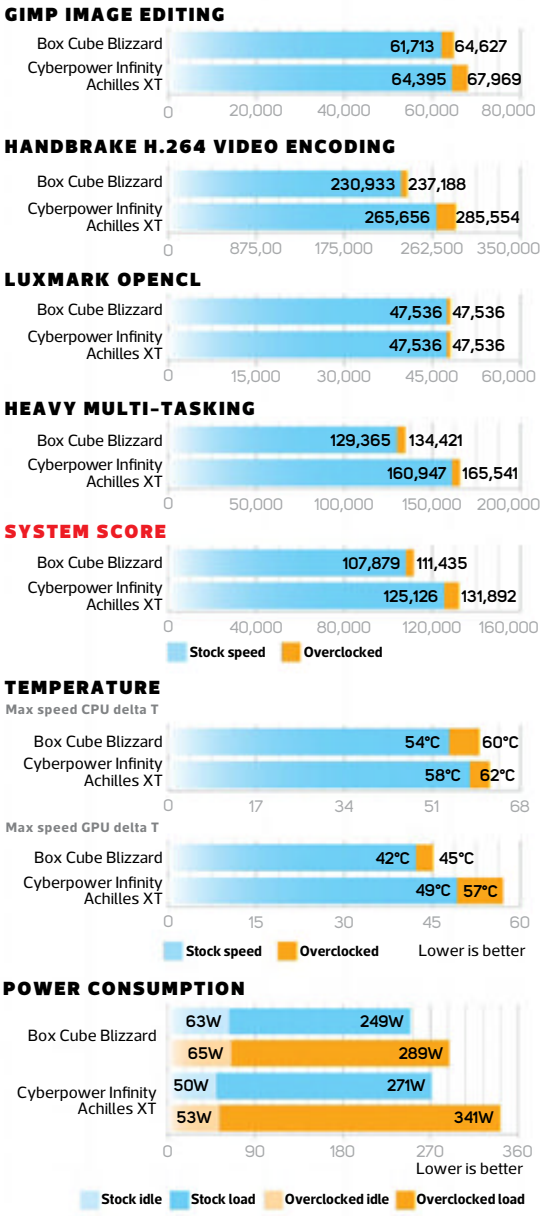
Verdict

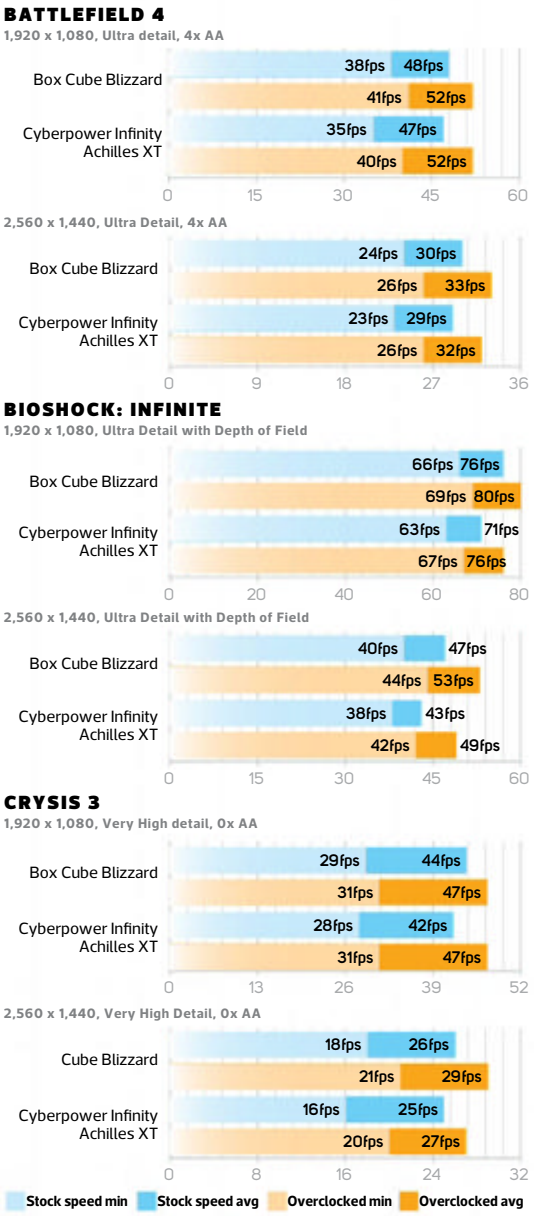
Both these systems offer ample power for games at 1080p, and some power at 2,560 x 1,440 too. The Box machine doesn't have as much processing power as the Core i7-powered Cyberpower, and the Infinity Achilles XT also wins in terms of storage with its M.2 Samsung SSD.

Instead of offering pure speed, the Box PC concentrates on design. Its two-tone theme looks fantastic, and it has plenty of upgrade room too. If you want a good-looking gaming system with plenty of room to grow, the Box Cube Blizzard is a fantastic rig, but the cheaper Cyberpower is quicker in multi-threaded workloads, and isn't far behind in games benchmarks. Both are well-built, well-balanced mid-range gaming rigs that will serve you well – you just need to choose the one that best suits your priorities.

MIKE JENNINGS

CUSTOM PC REALBENCH 2014





BOX

SPEED	HARDWARE	OVERALL SCORE
21/25	22/25	87%
DESIGN	VALUE	
23/25	21/25	

CYBERPOWER

SPEED	HARDWARE	OVERALL SCORE
22/25	21/25	87%
DESIGN	VALUE	
21/25	23/25	

Elite

Our choice of the best hardware available

Build a budget PC

Core components

The parts you'll need to build either PC. This kit list gives you a solid PSU, a decent quality case and the OEM version of Windows 7 Home Premium.

	NAME	SUPPLIER	FEATURED	PRICE (inc VAT)
1	NZXT S340	www.overclockers.co.uk	Issue 137, p54	£60
2	Corsair CS550M	www.scan.co.uk	Issue 135, p46	£66
3	500GB Seagate Barracuda ST500DM002	www.scan.co.uk	Issue 104, p72	£35
4	Lite-On IHAS124-14	www.dabs.com	Issue 99, p108	£10
5	Microsoft Windows 7 Home Premium 64-bit OEM	www.ebuyer.com	Issue 75, p46	£68

All-purpose PC

The parts you'll need to add to the core components to build a general-purpose PC. This machine will handle general computing tasks with no trouble, and will also cope with basic gaming, although you'll have to lower the detail settings. It features high-speed memory to boost the performance of the AMD APU's graphics system.

	NAME	SUPPLIER	FEATURED	PRICE (inc VAT)
	Gigabyte GA-F2A88XM-D3H	www.cclonline.com	Issue 126, p22	£53
	AMD A10-7850K	www.scan.co.uk	Issue 127, p17	£115
	8GB Corsair Vengeance Pro Series 2,400MHz DDR3	www.scan.co.uk	Issue 132, p22	£68
	SilverStone Argon AR01	www.scan.co.uk	Issue 132, p57	£26
			TOTAL	£501

Gaming PC

The parts you'll need to build a budget machine capable of playing the latest games at maximum settings on a 1080p monitor. The machine has a discrete graphics card, a highly overclockable dual-core CPU and high-speed memory. Meanwhile, the Z97 motherboard gives you headroom to upgrade to a faster CPU later.

	NAME	SUPPLIER	FEATURED	PRICE (inc VAT)
	ASRock Z97 Pro3	www.overclockers.co.uk	Issue 130, p50	£80
	Intel Pentium G3258	www.scan.co.uk	Issue 132, p17	£53
	AMD Radeon R9 280 3GB UPDATED	www.ebuyer.com	Issue 140, p42	£140
	Corsair Vengeance Pro Series 2,400MHz DDR3	www.scan.co.uk	Issue 132, p22	£68
	SilverStone Argon AR01	www.scan.co.uk	Issue 132, p57	£26
			TOTAL	£606

Recommended extra

A solid state drive will make a huge difference to the responsiveness of Windows, as well as boot-up times. We strongly recommend adding one to any build.

	NAME	SUPPLIER	FEATURED	PRICE (inc VAT)
	Samsung SSD 840 Evo 250GB	www.cclonline.com	Issue 128, p52	£88

Build a mid-range PC

Work PC

The parts you'll need to build a solid quad-core PC with plenty of upgrade potential. This kit list gives you an all-in-one liquid cooler and a K-series Core i5 CPU, meaning you can overclock it and get some serious processing power. We've managed to get the Core i5-4690K Haswell CPU up to 4.8GHz, so it has some serious performance potential. Also included is a solid Corsair PSU, a 512GB SSD and 8GB of high-speed memory. The core configuration assumes you won't be doing any serious gaming, however, and it relies on Intel's integrated graphics.

	NAME	SUPPLIER	FEATURED	PRICE (inc VAT)
	NZXT Phantom 530	www.overclockers.co.uk	Issue 127, p44	£98
	Gigabyte Z97X-SLI	www.overclockers.co.uk	Issue 130, p54	£90
	Intel Core i5-4690K	www.overclockers.co.uk	Issue 132, p18	£188
	Corsair Vengeance Pro Series 2,400MHz DDR3	www.scan.co.uk	Issue 132, p22	£68
	NZXT Kraken X41	www.overclockers.co.uk	Issue 138, p57	£80
	Corsair CS550M	www.scan.co.uk	Issue 135, p46	£66
	Seagate Barracuda 2TB ST2000DM001	www.scan.co.uk	Issue 104, p75	£60
	Lite-On IHAS124-14	www.dabs.com	Issue 99, p108	£10
	Crucial MX100 512GB	www.cclonline.com	Issue 131, p17	£152
	Microsoft Windows 7 Home Premium 64-bit OEM	www.ebuyer.com	Issue 75, p46	£68
			TOTAL	£880

Gaming PC

The graphics card you'll need to play current games at their maximum settings at 1080p and 2,560 x 1,440.

	NAME	SUPPLIER	FEATURED	PRICE (inc VAT)
	**1,920 x 1,080** AMD Radeon R9 280 3GB UPDATED	www.ebuyer.com	Issue 140, p42	£140
	**2,560 x 1,440** AMD Radeon R9 290 4GB UPDATED	www.ebuyer.com	Issue 140, p48	£229

Build a performance PC

Work PC

The parts you'll need to build a high-quality, fast PC that's ideal for multi-threaded workloads. This kit list features a high-quality, beautifully built case, and has a Core i7-4790K CPU. This processor's support for Hyper-Threading effectively splits the resources of the CPU's four physical cores into a further four virtual cores, meaning it can effectively handle eight threads at once. There's also a solid 850W PSU, giving you plenty of headroom for overclocking and adding multiple graphics cards, and an all-in-one liquid cooler.

	NAME	SUPPLIER	FEATURED	PRICE (inc VAT)
	NZXT H440 Special Edition UPDATED	www.overclockers.co.uk	Issue 140, p24	£125
	Asus Maximus VII Ranger	www.scan.co.uk	Issue 131, p20	£138
	Intel Core i7-4790K	www.scan.co.uk	Issue 132, p19	£273
	Corsair Vengeance Pro Series 2,400MHz DDR3	www.scan.co.uk	Issue 132, p22	£68
	NZXT Kraken X41	www.overclockers.co.uk	Issue 138, p57	£80
	SilverStone Strider Gold 850W	www.scan.co.uk	Issue 135, p56	£104
	Seagate Barracuda 2TB ST2000DM001	www.scan.co.uk	Issue 104, p75	£60
	Lite-On IHAS124-14	www.dabs.com	Issue 99, p108	£10
	Samsung SSD 850 Evo 500GB	www.dabs.com	Issue 138, p26	£180
	Microsoft Windows 7 Home Premium 64-bit OEM	www.ebuyer.com	Issue 75, p46	£68
			TOTAL	£1,106

Gaming PC

The graphics card you'll need to play current games at their maximum settings at 2,560 x 1,440 and beyond.

	NAME	SUPPLIER	FEATURED	PRICE (inc VAT)
	**2,560 x 1,440** AMD Radeon R9 290 4GB UPDATED	www.ebuyer.com	Issue 140, p48	£229
	**4K** 2 x Nvidia GeForce GTX 970 4GB UPDATED	www.dabs.com	Issue 140, p50	£500

Recommended extra

A discrete sound card gives you higher-quality sound when playing back or recording music.

	NAME	SUPPLIER	FEATURED	PRICE (inc VAT)
	Creative Sound Blaster Z	www.overclockers.co.uk	Issue 116, p42	£60

Build a 6-core workstation

Multi-threaded workstation

The parts you'll need to build a PC with serious power in multi-threaded workstation software, such as 3D rendering apps and optimised distributed computing software. The kit list features a 6-core LGA2011-v3 CPU, which is overclockable using the motherboard and cooler listed. Also supplied is 16GB of RAM, 1TB of solid state storage and a 1.2kW PSU, providing loads of headroom for adding multiple GPUs.

	NAME	SUPPLIER	FEATURED	PRICE (inc VAT)
	Corsair Obsidian 750D	www.scan.co.uk	Issue 123, p30	£133
	Asus X99 Deluxe	www.overclockers.co.uk	Issue 136, p20	£300
	Intel Core i7-5820K	www.overclockers.co.uk	Issue 134, p43	£326
	AMD Radeon R9 280 3GB UPDATED	www.ebuyer.co.uk	Issue 140, p42	£140
	16GB Corsair Vengeance LPX 2,666MHz DDR4	www.scan.co.uk	Issue 136, p14	£215
	Corsair Hydro Series H110i GT UPDATED	www.overclockers.co.uk	Issue 140, p17	£101
	Corsair Professional Series AX1200i	www.scan.co.uk	Issue 111, p40	£247
	Samsung SSD 850 Evo 1TB	www.dabs.com	Issue 138, p26	£350
	Seagate Barracuda 2TB ST2000DM0001	www.scan.co.uk	Issue 104, p75	£60
	Lite-On IHAS124-14	www.dabs.com	Issue 99, p108	£10
	Microsoft Windows 7 Professional OEM (or Windows 8.1 if you're using a 4K monitor)	www.ebuyer.com	Issue 75, p46	£109
			TOTAL	£1,991

4K gaming PC

This LGA2011-v3 system can support multiple graphics cards over 28 PCI-E 3 lanes, making it an ideal foundation for high-resolution PC gaming, replacing the graphics card listed above with two high-spec cards. We recommend using Windows 8.1, rather than Windows 7, if you're using a 4K monitor.

	NAME	SUPPLIER	FEATURED	PRICE (inc VAT)
	**4K** 2 x Nvidia GeForce GTX 970 4GB UPDATED	www.dabs.com	Issue 140, p50	£500
			TOTAL	£2,351

Build a mini PC

Core components

The parts you'll need to build either PC. This kit list gives you a solid PSU, 8GB of RAM, an overclockable Haswell CPU, an all-in-one liquid cooler and Windows 7 Home Premium. Also included is a short-PCB graphics card that can play current games at their maximum settings at 2,560 x 1,440, and a 512GB SSD.

	NAME	SUPPLIER	FEATURED	PRICE (inc VAT)
	Intel Core i5-4690K	www.overclockers.co.uk	Issue 132, p18	£188
	Corsair Vengeance Pro Series 2,400MHz DDR3	www.scan.co.uk	Issue 132, p22	£68
	Corsair H75	www.overclockers.co.uk	Issue 138, p46	£59
	Asus GeForce GTX 970 DirectCU Mini	www.overclockers.co.uk	Issue 139, p20	£282
	Crucial MX100 512GB	www.cclonline.com	Issue 131, p17	£152
	Seagate Barracuda 2TB ST2000DM001	www.scan.co.uk	Issue 104, p75	£60
	Lite-On IHAS124-14	www.dabs.com	Issue 99, p108	£10
	Corsair CS550M	www.scan.co.uk	Issue 135, p46	£66
	Microsoft Windows 7 Home Premium 64-bit OEM	www.ebuyer.com	Issue 75, p46	£68

Mini-ITX PC

The parts you'll need to build a pint-sized powerhouse.

	NAME	SUPPLIER	FEATURED	PRICE (inc VAT)
	Corsair Obsidian 250D	www.dabs.com	Issue 136, p41	£65
	Asus Maximus VII Impact	www.overclockers.co.uk	Issue 136, p52	£173
			TOTAL	£1,191

Micro-ATX PC

The parts you'll need to build a mini PC that doesn't take up as much room as a full-sized desktop.

	NAME	SUPPLIER	FEATURED	PRICE (inc VAT)
	Fractal Design Arc Mini R2	www.scan.co.uk	Issue 127, p46	£72
	Asus Maximus VII Gene	www.overclockers.co.uk	Issue 133, p18	£155
			TOTAL	£1,180

Cases

	TYPE	NAME	SUPPLIER	FEATURED	PRICE (inc VAT)
	**Budget ATX**	NZXT S340	www.overclockers.co.uk	Issue 137, p54	£60
	**Sub-£100 ATX quiet**	Fractal Design Define R5	www.scan.co.uk	Issue 137, p20	£87
	**Sub-£100 ATX performance**	NZXT Phantom 530	www.overclockers.co.uk	Issue 127, p44	£98
	**Air-cooling Sub-£150 ATX**	SilverStone Fortress FT05	www.scan.co.uk	Issue 139, p24	£131
	**Water-cooling sub-£150 ATX**	NZXT H440 Special Edition UPDATED	www.overclockers.co.uk	Issue 140, p24	£125
	**Water-cooling ATX**	SilverStone Temjin TJ07B-W	www.overclockers.co.uk	Issue 63, p87	£225
	**Mini-ITX tower**	Corsair Obsidian 250D	www.dabs.com	Issue 136, p41	£65
	**Mini-ITX cube**	Antec ISK600	www.overclockers.co.uk	Issue 126, p28	£50
	**Micro-ATX**	Fractal Design Arc Mini R2	www.scan.co.uk	Issue 127, p46	£72
	**Water-cooling micro-ATX**	Parvum Systems S2.0	www.overclockers.co.uk	Issue 129, p22	£140

Graphics cards

	TYPE	NAME	SUPPLIER	FEATURED	PRICE (inc VAT)
	**1,920 x 1,080 gaming**	AMD Radeon R9 280 3GB UPDATED	www.ebuyer.co.uk	Issue 140, p42	£140
	**2,560 x 1,440 gaming**	AMD Radeon R9 290 4GB UPDATED	www.ebuyer.com	Issue 140, p48	£229
	**High-end single-GPU gaming**	Nvidia GeForce GTX 980 4GB	www.scan.com	Issue 140, p52	£420
	**4K gaming**	2 x Nvidia GeForce GTX 970 4GB UPDATED	www.dabs.com	Issue 140, p49	£500
	**Mini-ITX**	Asus GeForce GTX 970 DirectCU Mini	www.overclockers.co.uk	Issue 139, p20	£282

Power supplies

	TYPE	NAME	SUPPLIER	FEATURED	PRICE (inc VAT)
	**Mid-range 550W**	Corsair CS550M	www.scan.co.uk	Issue 135, p46	£66
	**High-end 750W**	Corsair HX750i	www.dabs.com	Issue 135, p52	£118
	**Mid-range 850W**	SilverStone Strider Gold 850W	www.scan.co.uk	Issue 135, p56	£104
	**High-end 1.2kW**	Corsair Professional Series AX1200i	www.scan.co.uk	Issue 111, p40	£247

Networking

	TYPE	NAME	SUPPLIER	FEATURED	PRICE (inc VAT)
	**Router**	Asus RT-AC68U	www.dabs.com	Issue 128, p88	£160
	**Wi-Fi adaptor**	Asus PCE-AC68	www.scan.co.uk	Issue 128, p88	£70

Storage

	TYPE	NAME	SUPPLIER	FEATURED	PRICE (inc VAT)
	**Hard disk**	Seagate Barracuda 2TB ST2000DM001	www.scan.co.uk	Issue 104, p75	£60
	**250GB SSD**	Samsung SSD 840 EVO 250GB	www.cclonline.com	Issue 128, p52	£88
	**512GB SSD**	Crucial MX100 512GB	www.cclonline.com	Issue 131, p17	£152
	**1TB SSD**	Samsung SSD 850 Evo 1TB	www.dabs.com	Issue 138, p26	£350
	**NAS box**	Synology DS215J	www.cclonline.com	Issue 138, p17	£144

Monitors

	TYPE	NAME	SUPPLIER	FEATURED	PRICE (inc VAT)
	**24in monitor**	Dell U2414H	www.overclockers.co.uk	Issue 129, p43	£200
	**27in monitor (2,560 x 1,440)**	ViewSonic VP2772	www.cclonline.com	Issue 129, p60	£606
	**29in monitor**	Asus PB298Q	www.scan.co.uk	Issue 129, p52	£347
	**28in 4K monitor**	Asus PB287Q	www.scan.co.uk	Issue133, p44	£449

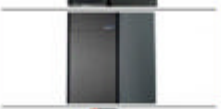
Peripherals

	TYPE	NAME	SUPPLIER	FEATURED	PRICE (inc VAT)
	**Budget mechanical keyboard**	Gigabyte Aivia Osmium	www.awd-it.co.uk	Issue 139, p40	£72
	**Mechanical gaming keyboard**	CM Storm Trigger-Z	www.box.co.uk	Issue 139, p44	£88
	**Mechanical MMO keyboard**	Corsair Vengeance K95	www.cclonline.com	Issue 123, p64	£125
	**Gaming mouse**	Logitech G402 Hyperion Fury	www.overclockers.co.uk	Issue 139, p53	£40
	**Wireless gaming mouse**	SteelSeries Sensei Wireless	www.box.co.uk	Issue 139, p61	£99
	**Flight stick**	Saitek X-55 Rhino H.O.T.A.S.	www.overclockers.co.uk	Issue 131, p29	£155
	**Steering wheel and pedals**	Thrustmaster TX Ferrari 458 Italia Edition	www.overclockers.co.uk	Issue 137, p32	£220

Audio

	TYPE	NAME	SUPPLIER	FEATURED	PRICE (inc VAT)
	**PCI-E sound card**	Creative Sound Blaster Z	www.overclockers.co.uk	Issue 116, p42	£60
	**USB sound card**	Asus Xonar Essence One	www.overclockers.co.uk	Issue 118, p44	£363
	**2.1 speakers**	Corsair SP2500	www.scan.co.uk	Issue118, p75	£170
	**Headset**	HyperX Cloud	www.scan.co.uk	Issue 130, p32	£55

Systems

	TYPE	NAME	SUPPLIER	FEATURED	PRICE (inc VAT)
	**Budget gaming PC**	Scan 3XS Z97 Performance GT	www.scan.co.uk	Issue 133, p60	£599
	**Quiet gaming PC**	Chillblast Fusion Serenity	www.chillblast.co.uk	Issue 138, p66	£1,499
	**Dream PC**	Scan 3XS Bear	www.scan.co.uk	Issue 125, p58	£6,999
	**Devil's Canyon gaming PC**	Scan 3XS Z97 Performance GTX	www.scan.co.uk	Issue 136, p60	£1,199
	**4K gaming PC**	Overclockers UK Infinity Vesuvius	www.overclockers.co.uk	Issue 131, p62	£4,108
	**Micro-ATX gaming PC**	AWD-IT Chimera i5 Dead Silence Gaming PC	www.awd-it.co.uk	Issue 135, p64	£949
	**Gaming laptop**	MSI GT70 2PC Dominator	www.overclockers.co.uk	Issue 129, p26	£1,320
	**Haswell-E PC**	Scan 3XS X99 Cyclone SLI	www.scan.co.uk	Issue 134, p60	£3,349

Games

Featured this month

RICK LANE / INVERSE LOOK

COWBOY BUILDERS

The game business' current crafting craze shows a lazy approach to game design, says Rick Lane

A quick preface to this month's column: I have never built anything. Well, that isn't completely true. Between six and 11 years old I enjoyed making Airfix models. But when it comes to building useful objects, my record is zero. Never mind advanced artisan skills such as bricklaying or carpentry, a simple home improvement job such as putting up a shelf or fitting a washing machine is way beyond my capabilities. As far as I'm concerned, DIY might as well stand for 'Do Iguanas Yawn?'

Yet even I, with my fingers like raw sausages and the spatial awareness of a blind panda, can see the problems with the game business' current crafting craze. It was inevitable that crafting would explode in popularity in the wake of Minecraft's astonishing success, yet the trajectory of crafting in games isn't what I anticipated. Most games inspired by Minecraft have focused on the survival aspect. The number of crafting games that have appeared in Minecraft's wake is actually fairly small, including Space Engineers and several more shameless Minecraft clones.

Instead, crafting has continued to gradually infiltrate other gaming genres, like tree roots growing beneath the foundations of a building. RPGs such as Skyrim and Dragon Age provide hundreds of recipes and component parts for smithing swords and brewing potions, while most open-world games attach a crafting system to their increasingly generic template. The strangest example of crafting logic I've seen is from the recently released zombie game H1Z1, where you can create a beautifully fashioned hunting bow by tearing your own t-shirt into rags, and combining those strips of cloth with a hastily gathered bundle of sticks.

While I'm all for games that encourage construction over destruction, the problem with relegating crafting to a side attraction is that it diminishes the sense of satisfaction that crafting is supposed to generate. Minecraft's crafting system operates on several levels; you collect raw materials to build tools, which you then use to source better raw materials to construct sprawling castles, vast rail networks and complex mechanisms. You go from an apprentice artisan following basic recipes to a master craftsman embarking upon huge construction projects entirely of your own devising.

> The problem with relegating crafting to a side attraction is that it diminishes satisfaction

Most other games with crafting features completely lack that creative tier. Instead, crafting is limited to fitting pre-designated parts into pre-designated slots. Then you press a button and your object magically appears, which communicates barely any of the effort it requires to fashion a sword, hammer or gun. What's more, in many of these games, the logic of the crafting system is often downright weird.

Take Dragon Age, for example, where you can forge weapons and armour by collecting pommels and blades, pauldrons and breastplates, before fitting them together. Except that isn't how blacksmithing works at all. A blacksmith forges parts from scratch, taking lumps of ore, separating the metal in a furnace and battering that metal into shape.

Such half-hearted systems make a mockery of the time, effort and skill investment that's the very essence of crafting. Of course, these blueprint-filling systems aren't present in these games to provide that satisfaction, but to tick a box so the game's marketers can say, 'Look! Our game has crafting in it too!' It's lazy game design, the developer equivalent of cowboy building. In short, don't trust a game that claims to include crafting when it isn't *about* crafting. Like the act itself, you need to commit to the work, or let somebody with more experience do it. CPC

Rick Lane is Custom PC's games editor. @Rick_Lane

Dying Light / £39.99 inc VAT

DEVELOPER Techland / **PUBLISHER** Warner Bros / **WEBSITE** http://dyinglightgame.com

When all its parts come together, Dying Light is a macabre delight. It's hardly an original game. It uses a premise so tired it's one sleepless night from falling into a coma, and its most interesting bits are shamelessly stolen from other, more innovative games. But developer Techland has sewn this monster together with grace and care, and the result is a fast, fun open-world game that occasionally sparkles with brilliance.

Dying Light takes place in the fictional city of Harran, an Arabian metropolis where gleaming skyscrapers stand alongside mazy slums. Oh, and zombies, thousands of them. You play Kyle Crane, a government agent parachuted into Harran to retrieve a stolen document from another agent who is fashioning himself as Lord of this beleaguered realm. Needless to say, the plan goes wrong, and Kyle ends up infected with the zombie virus and holed up with a group of survivors as he helps them search for a cure.

The main way Dying Light differentiates itself from other zombie games is via its Mirror's Edge-style parkour. Kyle is far more athletic than your average survivor, able to climb a building with ease and use rooftops as a relatively safe highway between the safehouses around the city. First-person platforming is one of the most difficult mechanics to get right in gaming, and Techland deserves a lot of credit, as Dying Light is one of the best representations yet.

Although platforming isn't quite as seamless as it is in Mirror's Edge – animation transitions between jumps and grabs can feel a little forced – the open world is cleverly designed to give you plenty of free-running options, and make those options clear. The experience feels just right – Kyle is nimble but his movements have weight and climbing isn't too fast or too slow. Also, death by falling is minimised either through using fairly short buildings or plentiful safe-landing zones such as car roofs or rubbish piles.

The same goes for combat. Fisticuffs in Techland's previous game Dead Island were unsatisfying, and the developer has clearly strived to remedy this issue. Weapons are weightier, zombies are more responsive to impact and your abilities have been greatly expanded. Early on, you unlock a dropkick ability, which is one of the game's best features. A well-timed dropkick can send a lone zombie plummeting off a rooftop to splatter on the street below, knock back a crowd of zombies to create an escape route, or send them stumbling back into an environmental hazard, such as a fire or a conveniently positioned set of spikes.

The upgrading and maintaining of weapons has been improved over Dead Island too. Weapons last longer and are easier to repair, which in turn makes adding effects such as fire or electricity damage more worthwhile. The only downsides are that the weapon customisation options

aren't as extensive as they initially appear, and the keyboard layout for inventory management is a confusing mess of randomly assigned keys.

As an action game, Dying Light is very well balanced, upping the challenge as it improves your abilities. Zombies come in all shapes and sizes, from your standard shambling corpse to the speedy, cat-like Virals and the Left 4 Dead-esque Special Infected. But it saves its best trick for after dusk. When the sun goes down, out come the Volatiles – zombies that match your speed and far exceed your strength, and which actively seek you out by prowling the streets and rooftops. At night, Dying Light is a completely different game, a mixture of Thief-like stealth and thrilling, dynamic chases that see you desperately scrambling for the nearest safehouse.

Dying Light's core systems make it fun regardless of what you're doing. Bashing your way through a clump of zombies or searching an abandoned pharmacy for medical supplies possess a satisfying low-level tactility that lends a powerful connection to the world around you. When it comes to specifically directing your action, however, Dying Light is less effective.

The story is distinctly uneven, its characters range from the surprisingly good (Stephen Merchant gives a great performance as survivor leader Brecken) to the typically terrible. A bigger problem is that you hardly spend any time with the characters. As the game sends you further afield, it introduces new characters rather than finding ways to stick with a core cast, which makes it almost impossible to establish a bond with any of them.

The actual campaign missions are fine, usually involving multiple objectives that send you to different locations, such as an abandoned school or a half-built apartment block. They're also smartly structured to let you freely use all your available abilities, never forcing you into a particular role. That said, no part of the campaign ever stands out, perhaps because Harran isn't a particularly memorable world. It's a city, filled with city-like institutions and infrastructure, and while it's undoubtedly beautifully designed and laid-out, its landmarks all merge into the same orange-brown blur.

Side-quests are equally plentiful, although too many of them involve traipsing around houses fetching mundane items for lazy non-player characters. Then there are various incidental activities, such as retrieving airdrops of supplies, rescuing endangered survivors and, bizarrely, running races. Sadly, none of these smaller distractions has any real significance, so they end up feeling like background noise – irritating blips on the map that try to distract you from the scripted quests.

The result is that Dying Light is bogged down by the weight of its content. Indeed, what felt like a good end-point turned out only to be the conclusion of the first act, opening up a whole new area; while providing a change of scenery, this didn't significantly evolve the game. That said, the excellent free-running and melee combat are just about sufficient to support the bloated running time, and both those systems are astonishingly hard to get right.

RICK LANE

OVERALL SCORE

82%

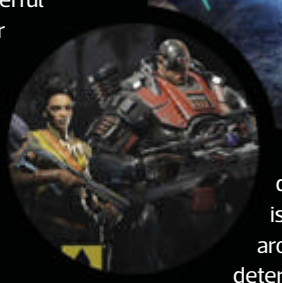
/ VERDICT

Despite its issues, Dying Light's fluid movement and terrific night play separate it from the ever growing horde of undead games.

Evolve / £34.99 inc VAT

DEVELOPER Turtle Rock / **PUBLISHER** 2K Games / **WEBSITE** www.evolvegame.com

Evolve is an extraterrestrial safari simulator that pits four human hunters against one lumbering monster in an ever-shifting multiplayer game of cat and mouse. Centred heavily around its Hunt mode, a round of Evolve begins with the monster evading an incoming hunter dropship. Initially, the monster is fairly weak, and must feed on roaming AI wildlife in order to grow in strength, ultimately evolving into a more powerful form. The hunters want to stop the monster beforehand, aiming to track, trap and kill it as quickly as possible.



To achieve this goal, the hunters are separated into four highly specialised roles. The trapper, for example, is primarily responsible for tracking the monster, and upon finding it, enclosing it inside a large energy dome that prevents it from running away. The Assault class can then deal heavy damage with a range of weaponry, while the Medic and Support classes try to keep the object of the monster's ire alive.

Evolve relies heavily on its players sticking to their roles and playing them well, which fortunately isn't too difficult. Undoubtedly the hardest role to play is the monster, as you must learn to sneak around the map so as not to leave tracks, and determine the best places to spring an ambush, such as small caverns or areas where the hunters may be distracted by other dangerous wildlife. The hunters' roles are more clearly defined, so figuring out how to play a Medic or a Trapper is considerably easier.

Conceptually, Evolve is fantastic, and at first, its ideas appear to be smartly implemented. Unfortunately, though,

OVERALL SCORE
60%

/ VERDICT
A lack of punch and an overly rigid game structure mean Evolve won't be likely to survive for long on your hard drive.

Grow Home / £4.99 inc VAT

DEVELOPER Ubisoft Reflections / **PUBLISHER** Ubisoft / **WEBSITE** www.ubisoft.com/en-GB/game/grow-home

Not only does Grow Home have an amazing concept, but its laser-pointed design is wholly committed to extracting every ounce of enjoyment from it, without any filler. This miniature masterpiece lends you control of a cheerful little robot called B.U.D, who is airdropped onto a picturesque planet by an orbiting dropship, and tasked with growing and climbing a gargantuan flower called the Star Plant. His ultimate objective is to retrieve one of its stratospheric seeds for cultivation on other planets.

The game focuses on the twin acts of climbing and growing, and both are excellent fun. Bud's animations are procedurally generated, so he reacts to the world geometry around him rather than relying on pre-recorded animations, which proves extremely useful for the climbing mechanic. Bud can attach his robotic hands to any surface using the left and right triggers of a gamepad (the preferred control method). Moving the analogue stick then directs Bud's free hand wherever you need it to go, while his legs automatically respond to his position.

OVERALL SCORE
92%

/ VERDICT
Uplifting, compelling and awe-inspiring, Grow Home is an unmitigated delight.

problems emerge within a couple of hours. The monster's attacks seem disconnected from the world around it, while the hunters' weaponry is distinctly lacking in punch. What's more, learning the different areas of each map proves difficult because they're so thematically similar, being all minor variations on drab green jungle and angular rock formations.

Evolve's biggest flaw is that every aspect of Hunt mode is so precisely defined that it leaves little wiggle room for experimentation and surprise. Consequently, the experience becomes repetitive extremely quickly. Developer Turtle Rock attempts to expand the game's appeal with several additional game modes, including an impressive five-mission Extraction Campaign, which is randomly generated using all the game modes, and alters the maps depending on which side wins each mission. Unfortunately, both the hunters and the monsters have a design that's so specifically focused on Hunt mode that they struggle to adapt to the alternative scenarios.

In fact, the struggle to adapt its idea into other scenarios is ultimately Evolve's downfall. It's an interesting experiment in multiplayer design, but it isn't one that's worth £35

RICK LANE

Although Bud seems ungainly at first, he quickly demonstrates his climbing proficiency. Rhythmically tapping the left and right triggers causes him to scramble up surfaces with ease. As you ascend the Star Plant's stem, you'll notice small, red-tipped stalks branching out, which you can grab to stimulate the plant's growth. Attaching a budding stalk to specific floating islands will cause the Star Plant to Grow, enabling you to climb higher.

You get an immense sense of achievement simply from looking down at the view. As you ascend higher, the planet's curve becomes visible, snow descends on the floating islands, and you can even spot your spaceship orbiting just above the planet's atmosphere. There are also dozens of islands to explore on your way, including a couple of large islands lined with caves that play home to strange wildlife, and are also littered with crystals that can upgrade your abilities, centred around a jetpack that allows you a brief burst of flight.

However, what makes Grow Home truly special is how it weaves its parts together. Its floral theme is imbued into the smaller systems as well as the broader game. For example, giant daisies can be used as makeshift parachutes, and fallen leaves as hang gliders. This theme of growth is complemented by a general tone of optimism and joy. Your mission leader, a computer named M.O.M, constantly sends you quirky jokes and messages of reassurance. It's all about growing, ascending and achieving.

There are a couple of minor issues with Grow Home. Bud's procedural animations occasionally go haywire, and the camera's preposterous zoom could do with some restraining. It's also only a few hours long, but that's reflected in the price. Indeed, Grow Home is perfect for filling a free evening, and it will be one of the best gaming evenings ever.

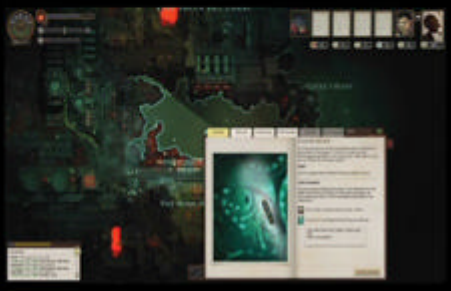
RICK LANE

Sunless Sea / £14.99 inc VAT

DEVELOPER Failbetter Games / **PUBLISHER** Failbetter Games / **WEBSITE** www.failbettergames.com/sunless

Sunless Sea is about learning through failure, exploring systems and environments, and discovering your way to success. At the same time, it's about stories. In fact, its focus on narrative is so strong that the main way to earn money in the game isn't to trade goods, but to tell tales. It's an eclectic cocktail, and one that won't be to everyone's taste.

It's set in Failbetter's exquisitely designed RPG world of Fallen London, an alternative universe where the greatest city of the 19th century fell through the Earth into a watery cavern, fracturing into an archipelago of dangerous, eerie islands. You play the ship's captain seeking these far-flung shores, hoping to earn enough fame and fortune to retire comfortably.



Sunless Sea twists the traditional role-playing conventions to its own ends. Your ship's abilities are determined by the officers you recruit on board, while income is earned mainly by trading stories great and small with various characters in the game. For example, when visiting an island, usually you can compile a 'port report' that can be sold back to London's admiralty board, while news from home can be exchanged with certain characters for supplies or fuel.

In addition, every island you visit has a unique storyline. Some islands can be explored immediately, but most require you to meet a specific criteria before you can proceed. Therefore, the islands of Fallen London are a fractured puzzle that must be carefully pieced together. It's all united by the script, which is splendid – sharp, sombre and sprinkled with a sardonic wit.

It's a shame, then, that many players will struggle to push past the first few hours. The problem isn't that Sunless Sea is difficult. Death is central to Sunless Sea, to the point where it sports a legacy system whereby a Captain who dies may leave something of use to the poor soul who follows in his ghostly wake. The issue is that what usually kills you in these early stages isn't a grog-induced brawl or an iceberg, but running out of fuel.

Sunless Sea is at its most difficult in the first couple of hours. Earning money is very tough in the offing, and nearly all of it must go on fuel and supplies to stand any chance of survival. Hence, instead of enjoying the sights and sounds, your focus is fixed almost entirely on fuel consumption, which is plain boring. Once you're past this stage, the game improves immensely. But if you die (and you will), you need to go through the miserable beginning all over again. All of which is a shame, because there's a dark and wondrous world waiting beyond Sunless Sea's brutal opening

RICK LANE

OVERALL SCORE
70%

/ VERDICT
There are great rewards lurking in Sunless Sea's vast ocean, but the game doesn't half make you work for them.

powered by GIGABYTE™

Quietpc.com

hear yourself think

www.quietpc.com/systems - 01653 668000

FREE DELIVERY

MONO ALL-IN-ONE

A high-end 1080p widescreen display combined with a top spec PC
Choice of graphics cards for desktop-calibre gaming performance
Beautiful flat design available in 21", 23" or 27" panel sizes
Available with up to 16GB RAM and up to a Core i7 4790K processor

From £689 inc. VAT

QUBE FANLESS SERIES

Incredible performance in a stunningly tiny aluminium chassis
Available in three sizes – NanoQube, MicroQube and MiniQube
Configurable with up to 16GB memory and a choice of six processors
Optional UHD 4K graphics; 3840 x 2160 @ 60Hz (Micro / MiniQube)

From £545 inc. VAT

NOFAN A490

Totally silent running – no moving parts, noise or dust
Available with up to 32GB memory and up to Core i7 4790K processor
Beautifully lightweight precision aluminium chassis
Air-cooled X490 version available with up to 8 cores and 64GB memory

From £979 inc. VAT

UltraNUC PRO FANLESS

Tiny, yet a very capable desktop PC which is the size of your hand
Tranquil PC H22 fanless monobloc chassis gives zero noise
Choice of Core i3 or Core i5 processor with Intel HD 5000 graphics
Configurable with up to 16GB memory and 2TB of storage

From £495 inc. VAT

Quiet PC is a North Yorkshire-based PC manufacturer which designs and builds award-winning silent and quiet computers for customers all over the world. With fifteen years in business, you can depend on our computers for speed, stability and silence. We also supply components separately for self-builds and upgrades.

Use offer code **FRODOBOT** on our website before Thursday 30 April to claim a special 5% discount for Custom PC readers!

Windows 7 · Windows 8.1 · ubuntu

intel inside CORE i7

TRUSTPILOT

★★★★★

Rated 9.9 / 10

over 1,600 reviews

RICK LANE / THE ENGINE ROOM

Flixel

Rick Lane talks to Adam Saltsman about the engine behind Canabalt, which was made to overcome the limitations of Adobe Flash

Unlike indie gaming, indie technology isn't widely discussed. While it's commonly understood that great games can be made by a team of any size, it's more readily assumed that game engines – certainly engines coded for third-party use – are exclusively the domain of large corporations. Yet this isn't the case. The indie tech culture is just as vibrant and creative as those small groups of developers creating unique and adventurous games, as you can see through the pixel-y lens of Flixel.

Flixel was created by Texas-based designer Adam Saltsman. Best known to us as the creator of endless runner Canabalt, in development circles he's arguably better known for his work on the stiletto-like 2D graphics engine on which Canabalt runs. But Flixel has also infiltrated its way into countless other games and software.

Flixel is an open source game library designed to work with Adobe Flash. It was built by Saltsman over a number of years as an alternative to Flash's rather cumbersome method of real-time graphics rendering. 'Flash has some significant shortcomings when it comes to making certain kinds of games,' Saltsman says. 'When you use all the normal tools that Flash gives you to display graphics or text on the screen, it can have major performance problems.'

Prior to building Flixel, Saltsman grappled with various systems, including Flash and OpenGL, and always struggled as he tried to balance his work and family life. Then in 2008, as Adobe faced increasing competition from systems such as Unity in the browser games space, it finally updated its ActionScript code, the basis for Flash. 'It lets you just open up a graphic and draw those pixels directly on the screen. It sounds hilarious, but we were actually waiting around to get that upgrade,' Saltsman explains. 'It was actually a big deal. It let you build an alternate way of rendering graphics, and a way that would let you put ten times as many things on the screen at a time.'

Saltsman recently created an Old Spice promotional game, developed in just five days. 'If there was a stress test for it, it was that,' he says

Consequently, Saltsman proceeded to build his own graphics renderer for Flash, intending it to be simple, accessible and, above all, fast. 'It's not unlike pixel shaders in some ways, where you can draw a complicated scene to a single polygon, and that's how your graphics engine works. It's similar to that, but in 2D.'

How Do You Do It is one of Saltsman's favourite Flixel games

Although it ended up being a tool for making games, Saltsman says Flixel wasn't created independently for this purpose. Rather, Saltsman would code little games using ActionScript, and Flixel gradually came together as and when he needed a new development tool. 'Basically, I made a game and needed a way to play back some frame-by-frame sprite animation. So I made a bad version of that [object] class,' he says. 'After three or four prototypes, some of which were public and some of which weren't, the most basic building blocks of what Flixel would become were there.'

Saltsman sums up Flixel as being 'used before it was designed', which is partly what makes it such an accessible game creation tool. Flixel is broken down into approximately 20 different functions, which can be used to quickly assemble a simple

game prototype. For example, levels can be built using a straightforward tile-placement system, enabling the designer to construct a basic platforming level within minutes by clicking and placing sequences of square tiles.

The fact that Flixel was designed according to Saltsman's needs also explains why some of its features appear to have random functions, such as the aforementioned playback feature. Flixel is coded to be deterministic, meaning a line of code will always produce the same result on screen. Consequently, that same code can easily be rewound and replayed without the result being altered, simply by keeping track of keystrokes and the random seeds the engine generates.

This feature may not appear to have much use when it comes to making a game, but precision replays are incredibly useful for debugging one, especially when, as is the case with Flixel, you can click through individual frames to spot the tiniest collision error. 'It's like being able to hold up a magnifying glass on a specific little span of time,' Saltsman summarises.

A more functionally obvious feature of Flixel is its impressive 2D particle generator. In Flixel, particles are designed to be extremely simple to work with. 'You can make a particle emitter in one line of code,' Saltsman says. In addition, tweaking the parameters of the emitter to determine the particles' amount, velocity, or whether they should bounce off surfaces is straightforward and intuitive. Again, it's ideal for prototyping, lending your game a little visual spectacle with minimal effort.

The ease with which Flixel can be used, and the speed with which it can cobble together games, means it's acquired a broad user base. Games made using Flixel include the in-depth survival sim NEO Scavenger, and the Indie Game Fund Finalist How Do You Do It, a comical physics-based game focused on learning about sex, which Saltsman identifies as one of his favourites. In addition, because Flixel is open source, pieces of its code have found their way into a huge range of games and other development programs, including the climbing game GIRP and the game-making app Stencyl. 'We made it MIT-licensed so it could grow and turn into other things,' Saltsman says.

Canabalt is the most well-known game to use Flixel. Designed for a one-button game-jam, it became the template for the endless-runner genre

As for the future of Flixel, although Saltsman is pleased with how the engine has taken off, he increasingly sees its limitations. Despite having created all these intuitive tools, he only uses a couple of them now. Instead, he has discovered a more flexible way of working within Flixel. 'There are "groups" in Flixel, which are like a mash-up of a layer in Photoshop and an Object Pool from a modern game engine,' he explains. 'It's immensely powerful, and it's what I want. It's all I use in Flixel now'

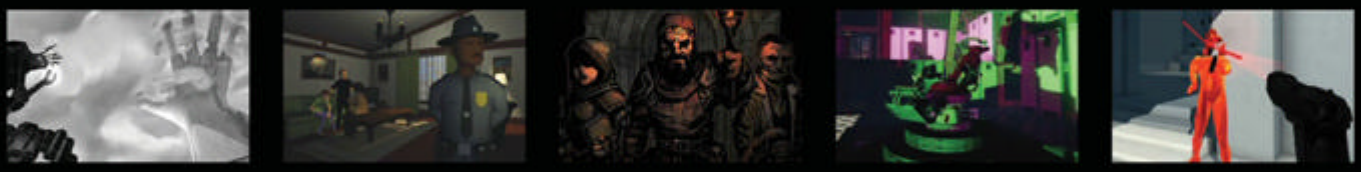
Rather than using a specific tool for a specific purpose, instead Saltsman builds games in Photoshop-style layers, writing a brief command description for each layer and then pooling them together in function-defined groups. These grouped objects can then be recycled by the game rather than created and destroyed as the graphics renderer uses them, which is economical in terms of CPU usage, as well as being creatively flexible.

Saltsman has considered updating Flixel to prioritise this new approach, but he feels it isn't really Flixel's intended use. 'Flixel was always for me. I had no free time. I wanted to be able to make little games,' he says. 'I can't really do what I want with game libraries next as an update to Flixel, because it means throwing away everything people like about Flixel.'

In other words, Saltsman has essentially graduated from the simple, accessible software that he designed for himself. Given this experience, it will be fascinating to see what he comes up with next. CPC

Fathom was one of the first games Saltsman made in Flixel. You can see the tile-based level design

Foddy's physics-based climbing game GIRP uses code sourced from Flixel



INDIE CORNER

You know the drill by now. One article; five fascinating indie games, courtesy of Rick Lane

The Magic Circle

DEVELOPER Jordan Thomas / **RELEASE** 2015
WEBSITE www.magiccirclegame.com

The Magic Circle comes from Jordan Thomas. Formerly at Irrational Games, Thomas oversaw the creation of BioShock's incredible Fort Frolic level, and was creative director on BioShock 2. The Magic Circle represents his first independent development, which has an interesting premise.

You play a hero trapped in an unfinished remake of a fictional 1980s adventure game. This faux reboot has languished in development hell for years, and the game's half-finished characters have grown tired of the designers toying with them like the devious gods of classical mythology. You're tasked with using the developer's code against them to stop their endless interference, and get the game finished.

It's a commentary on the development process and the idea of computer code as esoteric magic. The half-finished world is populated by creatures with unique AI behaviours and, by drawing a 'magic circle' around them, players can alter those behaviours. For example, by hacking the queen of a hive of insects, players can copy its hive-mind ability code, which can then be pasted into the AI brains of other creatures in the game, such as roaming, dog-like animals called Howlers.

Virginia

DEVELOPER Variable State / **RELEASE** 2015
WEBSITE http://variablestate.com/virginia

While detective fiction is a staple of film, TV and literature, most games revolving around crime, such as Grand Theft Auto or Thief, put you in the shoes of the criminal rather than the police. Meanwhile, the few games focused on gumshoes, such as LA Noire, struggle with the rigours of police procedure. Virginia looks to change that situation.

It's an adventure game inspired by 1990s TV serials such as Twin Peaks and The X-Files, set in a small US town where the ordinary and the extraordinary overlap. You play a newly fledged FBI agent searching for a missing boy, but within minutes of the opening, you're also asked to investigate your partner, who accompanies you through the game. The few available images show promise, with vibrant, block-colour 3D visuals that are exquisitely detailed and nail that small-town America vibe. However, the few details available from the developer are simultaneously intriguing and concerning.

Firstly, there's no dialogue – the story is told through gestures and environmental detail, and the developer is focusing entirely on story, without any puzzle solving or exploration. Being constantly ferried about a world to watch characters mime at each other could end up dull. Nevertheless, if the story is good, the idea remains exciting.

Darkest Dungeon

DEVELOPER Red Hook Studios / **RELEASE** Out now (Early Access)
WEBSITE www.darkestdungeon.com

Darkest Dungeon is a punishing game set in the sprawling, haunted undercroft of an old mansion. You control a party of four adventurers who set off to battle the monstrosities within it, while plundering whatever treasure may lurk in the depths of this subterranean maze. Although it boasts a striking art style, the basic structure isn't new. You gradually explore the dungeon's many rooms, battle strange creatures in turn-based combat and increase your character's abilities. Should one of them die, they're lost forever and must be replaced.

What makes Darkest Dungeon smart is the way the mindset of characters alters their behaviour. All characters can be affected and afflicted by a wide variety of physical and mental traits. A character who is over-stressed by the innumerable horrors they face may begin to verbally abuse their companions, increasing their stress levels. Meanwhile, characters who become irrational might flout the player's orders. Characters can also become paranoid, claustrophobic, fearful, and even succumb to bouts of kleptomania.

The game was recently released on Early Access, but it's already fairly complete, and its rough edges are mostly issues of balancing rather than missing features. We hope to have a review soon.

Albino Lullaby

DEVELOPER Ape Law / **RELEASE** 2015
WEBSITE http://albinolullaby.com

YouTube may have breathed new life into the 'jump scare' genre, because apparently many people like watching teenage boys squeal like distressed monkeys on the Internet, but horror is a much broader pool, with various methods of sailing through it. Thankfully, Albino Lullaby looks set to be charting a course that's very rare indeed.

Developed in Unreal Engine 4, its fabulous colour scheme and stark lighting are a far cry from the dilapidated architecture swathed in shadow that's the usual fare in horror games. Developer Ape Law is opting for a much more absurdist tone to its terror, accepting its fate as a virtual haunted mansion ride and running with the idea rather than fighting against it. So while the gurning faces of its strange denizens are undoubtedly unnerving, they're also subversively gleeful rather than outright terrifying.

Perhaps most interestingly of all, it's a ride that can be rearranged at whim. Early in the game you find a room with a lever. Pulling this lever causes the *entire* mansion to reorganise its rooms around you, through a vast network of clockwork mechanisms and whirring gears. Ape Law intends to deliver Albino Lullaby in an episodic format , but a 30-minute demo is available now if you fancy trying it.

SuperHot

DEVELOPER The SuperHot Guys / **RELEASE** Summer 2015
WEBSITE http://superhotgame.com

SuperHot is a first-person shooter in which time only moves when you move. Stand completely still and your enemies remain motionless. Bullets hang harmlessly in the air, and the flames from gun barrels freeze like tiny icebergs. Take a step forwards, however, and the action begins to flow again.

This mechanic transforms the age-old FPS format into an ever-evolving puzzle, as you figure out the best path to weave through enemy gunfire in order to slice up your foes with your sword, or how to keep moving so that your gunshots hit the target while your opponent's bullets miss.

Initially created as a prototype for a seven-day FPS game-jam, SuperHot graduated to full-blown development with the aid of a remarkably successful Kickstarter campaign. The prototype is freely available on the SuperHot website, and gives a good demonstration of the basic systems. The full game will include more detailed environments, character models and particle effects, and hopefully more challenging opponents. CPC

JIM KILLOCK / DIGITAL RIGHTS

Digital heists

Jim Killock asks if the GCHQ hacks targeting Google, Gemalto and other law-abiding companies are genuinely in the public interest

Part of the glamour of spies is that they break the rules. They pick locks, search drawers and bug hotels. They steal, lie and entrap people. Somehow, they're able to behave pretty much like criminals, but do it because they're protecting us. So we let them get on with it, and hope they're supervised well enough to know when to stop. We expect the agencies protecting us to target criminals when they behave illegally. However, the growing evidence about British intelligence organisation the Government Communications Headquarters (GCHQ) suggests it has an interesting way of defining when it's targeting criminals and when it needs to stop.

Of course, we know about mass collection of data when it travels from the UK to the USA. We've heard about TEMPORA, and authorised access to the databases of major Internet companies via the NSA's PRISM scheme. But the hacks and taking of data from organisations themselves? These activities must be exceptional – surely we'd be talking about organisations that are fronts for terrorism?

No. In fact, as we've found out thanks to Edward Snowden's revelations, reported in The Guardian and elsewhere, it's often hacking law-abiding companies that you would expect to fully cooperate with legal requests from a court or government. And most of the reported incidents seem to involve GCHQ, sometimes on its own, and sometimes cooperating with the NSA.

The first time we learned about these activities, GCHQ was alleged to have broken into Google's internal cable system, moving data from one data centre to another, without crossing the Internet. Google wasn't encrypting this data in transit, because it assumed nobody had any access to it. GCHQ could then take huge amounts of the data directly from Google's customers, and then make it available to the NSA, for whom it would have been illegal to acquire data in this way.

> Why didn't the agencies ask for what they needed under a warrant? Why did they need to make an indiscriminate haul?

That's shocking enough, especially for the companies involved. Why didn't the agencies ask for what they needed under a warrant? Why did they need to make an indiscriminate haul? Google has had to reinforce its security to make sure it's much harder for GCHQ to access its data another time.

The next time we heard about such a break-in, GCHQ had reportedly broken into the networks at Belgacom, Belgium's major telecommunications provider. The GCHQ had apparently used fake LinkedIn requests to security employees to bag access to their computers. Complicated network intercepts would redirect the LinkedIn requests to fake pages, which would then be used to help install malware via the Belgacom employees' web browsers.

Belgacom has had to conduct a huge clean-up operation to reassure its customers, which include the European Parliament and Commission. The £12m clean-up operation was later criticised by people involved as being half-hearted, and aimed at reassuring customers rather than fully removing GCHQ access.

The latest revelations, from this February, may affect you directly. One of the biggest manufacturers of mobile SIM cards is based in the Netherlands, called Gemalto. In this case, similar techniques were

reportedly used to break into Gemalto and install malware, guaranteeing GCHQ access to its networks at the highest level. GCHQ then reportedly used its access to steal the encryption keys installed in millions of SIM cards.

Paul Beverly, a Gemalto executive vice president, told The Intercept that he was 'quite concerned that this has happened ... The most important thing for me is to understand exactly how this was done, so we can take every measure to ensure that it doesn't happen again, and also to make sure that there's no impact on the telecom operators that we have served in a very trusted manner for many years. What I want to understand is what sort of ramifications it has, or could have, on any of our customers'. Later on, Gemalto claimed that 'initial conclusions ... indicate that Gemalto SIM products (as well as banking cards, passports and other products and platforms) are secure and the company doesn't expect to endure a significant financial prejudice'.

Gemalto seems to be following the same pattern as Belgacom. Its interests appear to be primarily financial, aiming to reassure its customers and shareholders. There are further accusations of GCHQ having unauthorised access to mobile operators' customer services and billing systems too. Its ability to hack into systems via malware and software vulnerabilities is now well-known, as is its apparent disregard for whether or not a company is a law-abiding entity. So let's just step back and assess how GCHQ can claim that its activities are 'necessary, legal and proportionate'.

GCHQ appears to be trying to access material, often in countries such as Somalia or Yemen, where it can claim there will be targets of interest, and it does have an interest in finding out about extremists, political instability and possible terrorist organisations.

But is compromising a company such as Gemalto, and large volumes of its customers' data, legitimately in its interest?

In the case of Belgacom, the targets may also include European institutions. Is that legitimate? Does it justify running an operation that's cost at least £12 million in a clean-up operation? GCHQ can probably claim it can hack if it likes. Although there's no national security get-out clause in the Computer Misuse Act, there are other acts that allow such activities.

At the end of the day, these legitimate businesses have done nothing wrong, and they're run in allied countries with responsible law enforcement. Why should GCHQ be breaking into their systems to undertake ongoing data heists? Why can't GCHQ ask the Netherlands or Belgian governments for the co-operation it needs?

The reaction of politicians is surprising too. The attitude seems to be that spies will, you know, spy. What do you expect? Personally, I expect these agencies to act scrupulously, in the knowledge that they exercise vast power. Above all, I expect them to target criminals and criminal organisations, not stock market-listed companies.

Politicians who aren't paying attention need to ask about the consequences. You might say these events look lawless and arbitrary, if you're on the receiving end. GCHQ is running some very serious risks, with reputational consequences for our standing in the world.

On one level, GCHQ seems to have translated analogue expectations into the digital world. It used to be easy to get material from a small number of companies, and it expects today to have access to everything, everywhere, all the time. But in its mission to achieve this goal, it doesn't stop in its attempts to compromise networks and companies, whether through legal arrangements or clandestine operations.

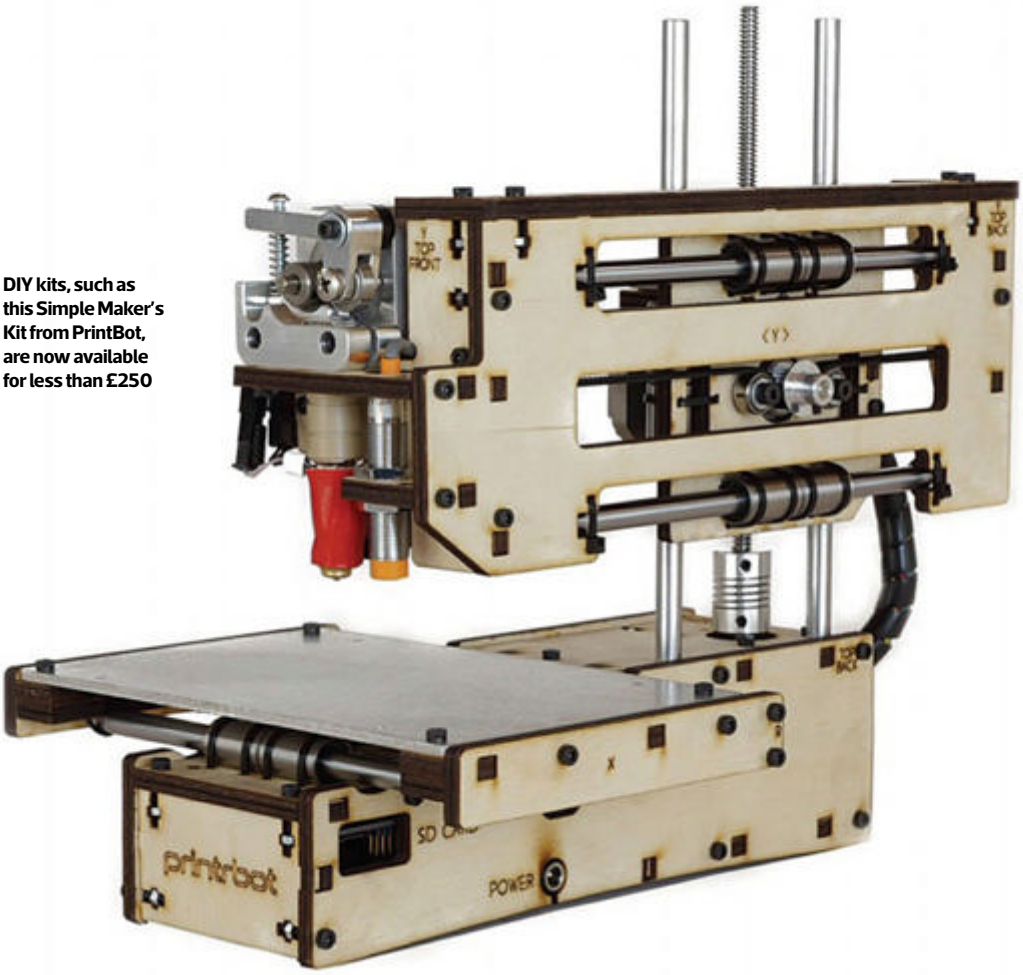
At another level, GCHQ seems to have grasped the digital world better than any other arm of government. While the UK has failed to organise getting fibre-optic broadband to every door, introduce IPv6 or match Internet speeds in South Korea and Singapore, GCHQ has confidently announced its strategy to 'Master the Internet' and has built capabilities to match. CPC

Jim Killock is executive director of campaign organisation The Open Rights Group (www.openrightsgroup.org) @jimkillock

THE PC MODDER'S GUIDE TO 3D PRINTING

IF YOU'RE A PC MODDER, OR IF YOU'VE EVER WANTED TO PRINT SMALL OBJECTS THAT YOU JUST CAN'T FIND ANYWHERE ELSE, 3D PRINTING CAN BE VERY USEFUL. ANTONY LEATHER LOOKS AT WHAT TYPES OF PRINTERS ARE AVAILABLE, HOW TO DESIGN AND PRINT YOUR OWN OBJECTS, AND WHY OWNING A 3D PRINTER CAN BE WORTHWHILE


CUSTOMPC
Cube



DIY kits, such as this Simple Maker's Kit from PrintBot, are now available for less than £250

While they've yet to become as popular as inkjet printers, 3D printers have certainly captured a lot of headlines recently. Sending design files for wrenches into space for astronauts to print out is all very well, but many printer manufacturers would also really like to see their machines in the home, in the hands of hobbyists. The machines are certainly becoming more affordable, with DIY kits now available for less than £250.

Rather than just being the latest must-have gadgets, though, 3D printers are genuinely useful tools for all manner of tasks. We've seen plenty of PC modders using them to create parts for their projects, and in some cases, they've printed entire cases too. Not only that, but we've seen 3D printers used to create tools, adaptors and pretty much any object you can design in a rendering program.

Over the next few pages, we'll be looking at what types of printer are available, the costs involved, how to print an object and the ways in which 3D printers are useful for PC enthusiasts and modders.

Types of 3D printer

Most of the smaller 3D printers you'd want to use at home use plastic-based materials. The most common material (and certainly one of the cheapest) is PLA, which is bought in spools and fed into the printer. It's then melted and extruded through nozzles before being laid down in thin layers, building up a 3D object. Many cheaper printers, particularly models that are available in kit form, use spools of plastic filament that cost around £20 per kg.

The number of objects you can make per spool will vary greatly depending on their solidity, but in general, a typical spool can create 40 or so matchbox-sized objects. The main differences between 3D printers that use plastic filament concern the maximum print size, the print resolution and print speed. Print sizes usually measure between 4in^3 and 10in^3 for a single object. Meanwhile, the print resolution is a lot like the resolution on your monitor – the higher the resolution (usually measured microns, where lower is better), the smoother the finish. For instance, a resolution of 200 microns results in fairly visible lines from the print nozzles, while a resolution of 50 microns results in a much smoother-looking object.

The downside is that higher-resolution objects take longer to print, which is where time becomes a consideration. Some cheaper printers are capable of printing at fairly high resolutions, but even matchbox-sized objects can take many hours to print out at these settings. Generally, the more expensive models offer larger print sizes, higher resolutions and faster print times.

NUMEROUS COMPANIES OFFER 3D PRINTING SERVICES WHEREBY YOU SEND THE COMPANY A DESIGN FILE, AND IT WILL PRINT YOUR OBJECT FOR YOU

Plastic filament printers are the most common models among hobbyists, but there are several other types too. Some use liquid resin that's cured by lasers and offers much higher resolutions than plastic filament printers, but these printers also cost a lot more both to own and operate. Companies that offer professional 3D printing services often use selective laser sintering (SLS) printers.

Print at home or away

While the cost of owning a 3D printer is now cheaper than ever, you may only want to print a few objects in one go, and not have a need to use a 3D printer again. In addition, you may need a high-quality or extra-large print that's only possible to produce on a high-end printer that costs tens of thousands of pounds.

Thankfully, there's one easy way around this dilemma. Numerous companies offer 3D

The advantage of using a third-party service is that you get access to very high-quality SLS printers – great for these parts from Alex Banks' Vesper project (see p93)

printing services whereby you send the company a design file, and it will print your object for you. These companies can even correct errors with the design that could result in a failed print.

One such company is **www.3dprint-uk.co.uk**, which offers high-quality printing using an SLS printer with nylon. At 20p per cubic centimetre, the price is more expensive than printing the object on a PLA-based printer. This higher cost is partly due to the fact that it's being printed at a higher resolution using more expensive materials, but also because this price is based on the total volume of an object. For example, if you print a hollow cube, you'll be charged for the total volume, not just the volume occupied by the material. You also have to wait a few days for delivery.

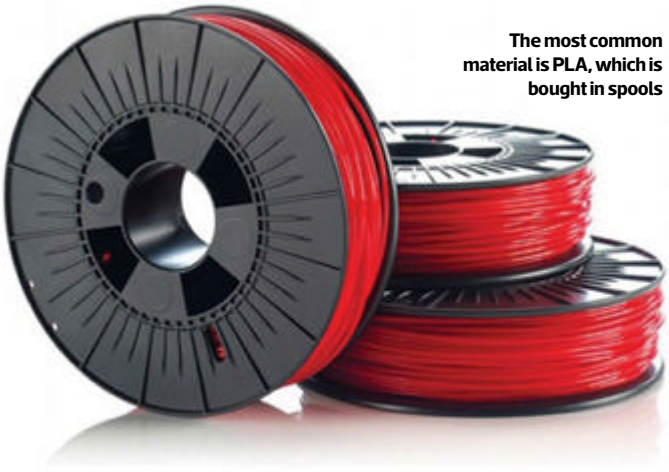
How do you print an object?

If you've never set eyes on a 3D printer, you probably have little idea how the whole process works. Printing a 3D object is actually quite easy, and not dissimilar to the process of printing a document on a normal inkjet printer. You create a file, upload it to the printer, adjust various settings and click the Print button. There isn't much more to it than that. In the below example, we'll show you step by step how it's done with a standard 3D printer.

Download a pre-rendered STL file

Whether you're uploading a file to your 3D printer or sending it to a company to print for you, the easiest file format to use is STL. Most 3D printers can print directly from these files, and all 3D printing services accept them too. There are two ways to create one.

You can download a pre-rendered STL file from a number of object databases, such as **www.thingyverse.com**. There are tens of thousands of objects available from these databases in a range of formats, including STL files. You just need to download one and upload the file to your printer.

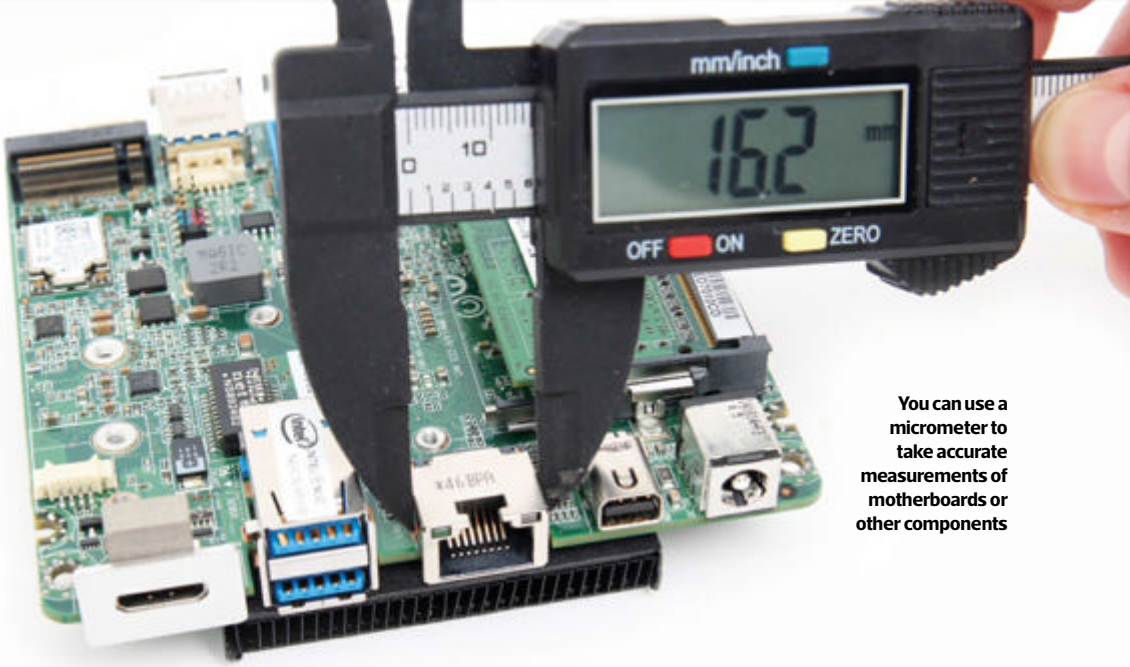


The most common material is PLA, which is bought in spools

Create your own design

If you can't find a suitable file online or maybe one that needs reshaping a bit, we've included a complete walk-through in this month's modding guide on how to create a 3D object using the browser-based design program TinkerCad (**www.tinkercad.com**). It's fairly easy to use and is adept at creating text ad well as simple or detailed objects that are accurate down to 0.1mm. You can also upload files so if you find an object online, you can alter it to suit your needs.

If you're already used to other 3D rendering programs, many can export your designs as STL files. Google's SketchUp is free to use and more flexible than TinkerCad plus there are even more SketchUp-created files out there than there are on Thingyverse too. However, you'll need to add in the SketchUp STL extension in order to import or export designs as STL files. You can download it at **http://tinyurl.com/sketchup-stl-plugin**. One essential tool for the job of designing your



You can use a micrometer to take accurate measurements of motherboards or other components

objects is a micrometer, which you can use to take accurate measurements of motherboards or other components in order to create 3D designs.

Upload your design

Now you have your STL file, you need to upload it to your printer. This job can be done in a variety of ways. Some more elaborate printers connect to Wi-Fi networks, allowing you to print almost as easily as with a network-connected printer. Others require the file to be uploaded using a USB stick. The software varies depending on the model of printer you use, but even the cheap kit-based printers, such as those made by PrintrBot, include software that's fairly easy to use.

Strength, fill and supports

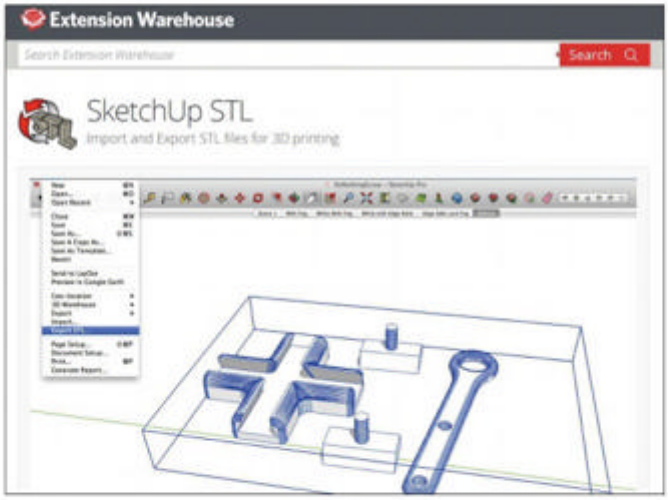
With your design uploaded to your 3D printer, you now have to make a few decisions. There are several options concerning print resolution, density and strength that you need to consider, depending on the type of object you're making. If you're printing an ornament, then you'll want to use a high resolution/low micron count. The printing software will show the resolution in millimetres, with the lower number representing the width of the lines used by the printer – the lower the width, the greater the detail, but bear in mind that higher-resolution printing takes longer.

If your object doesn't need to be strong, and won't be stressed or bent, then you can use low density and simple fill patterns, reducing print times and using less material. With our example, a hexagonal fill pattern can be selected to provide the greatest strength, along with a strong density setting.

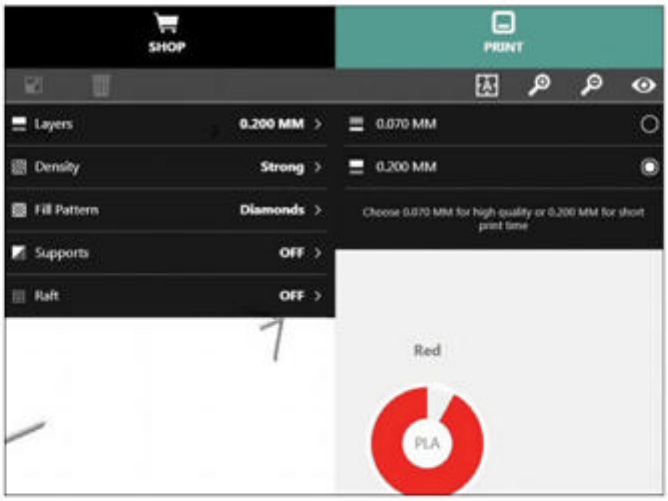
You also need to consider rafts and supports. As their name suggests, the latter are used to support your object, especially if it's a top-heavy design or if it features overhangs. For example, if you printed a teacup, you'd want to print a support under the handle to prevent it dropping while it's printed – think of it as scaffolding for your object. In addition, if you're printing a large, solid and flat object, you may want to use a raft. This process involves creating a base for your object that's printed beneath it, which can help to prevent uneven cooling of the object that can cause warping.

Finally, you need to prepare your printer for printing. It's always best to calibrate and level the printing surface first – the manual will advise you on how to do this job best for your specific model. You also need to apply an adhesive surface to the printing surface. Many people use painter's tape, which allows the object to be easily removed once it's been printed. It also

SOME MORE ELABORATE PRINTERS CONNECT TO WI-FI NETWORKS, ALLOWING YOU TO PRINT ALMOST AS EASILY AS WITH A NETWORK-CONNECTED PRINTER



Google's SketchUp is free to use, but you'll need to install the SketchUp STL extension in order to import or export designs as STL files



The printing software gives you the option to print in low resolutions for quicker print times, or increase the strength of the object

3D PRINTER

3D Systems Cube 3 / £1,073 inc VAT

SUPPLIER www.printerland.co.uk / **MODEL NUMBER** 391100

The Cube 3 is aimed at home users, but it's still quite pricey; at over £1,000, it's more than twice the price of some DIY kit 3D printers. However, the Cube 3 tries to introduce you to the world of 3D printing as quickly and easily as possible, and it looks a little like a fancy inkjet printer or stylish PC case – you'd be quite happy to have it in your house.

In terms of size, the Cube 3 can print objects measuring up to 6in³, which is above average for this size of printer, but some of its competitors can print slightly larger objects. Unlike some 3D printers, though, the Cube 3 doesn't use standard filament spools – instead, it uses £40 proprietary cartridges. You can still buy filament in a range of colours, but you can't refill or reuse them, while standard filament for a spool-fed printer costs half the price.

It can print in two colours thanks to its dual cartridge slots and nozzles

On the plus side, the Cube 3 can print in two colours thanks to its dual cartridge slots and nozzles. You can't mix colours, but the Cube 3 can print different portions of the same object in different colours. The cartridges are easy to use too, and they clip into place in much the same way as an ink cartridge. With your cartridge installed, you then need to calibrate the printer and you're ready.

You configure the Cube 3 via a touch-screen on the side, which allows for control over calibration and, as the Cube 3 has a built-in Wi-Fi adaptor, you can connect it to your router too, allowing you to send files over the network. Alternatively you can connect it directly to your PC, or use the USB port to transfer your design files to it without having to use a computer.

The included software allows you to import your design files, select the print colour and adjust print settings such as the resolution or fill pattern. It's a little clunky, but it works fine. Unlike using an inkjet, though, you still need to fiddle around with the printer before it gets going, as you need to apply some of the included glue to secure prints to the print pad. It's much like PVA glue, and it acts to anchor your object to the print tray and make it easy to remove afterwards. Printing can take place at 70 microns or 200 microns, although the former is painfully slow when printing medium and large objects. However, you then reap the rewards of higher print resolutions and the Cube 3's 70 micron setting offers better quality than many of its cheaper rivals.

Conclusion

The Cube 3 is expensive to buy and own, but it arguably offers the easiest way by far to get into 3D printing. With its Wi-Fi support, its compact, mess-free cartridges and its simple design, it's more suited to a home environment than many other 3D printers. You can save a wad of cash by opting for a kit-based printer, of course, but if you want a high-spec model that you can set up and start printing in less than half an hour, the Cube 3 is the machine for you.

ANTONY LEATHER

/SPECIFICATIONS

Dimensions (mm) 335 x 240 x 340 (W x D x H)

Weight 10kg

Connectivity USB port, Wi-Fi

Materials ABS, PLA (cartridges)

Layer thickness 70 microns or 200 microns (0.07mm / 0.2mm)

DESIGN 31/40

FEATURES 32/30

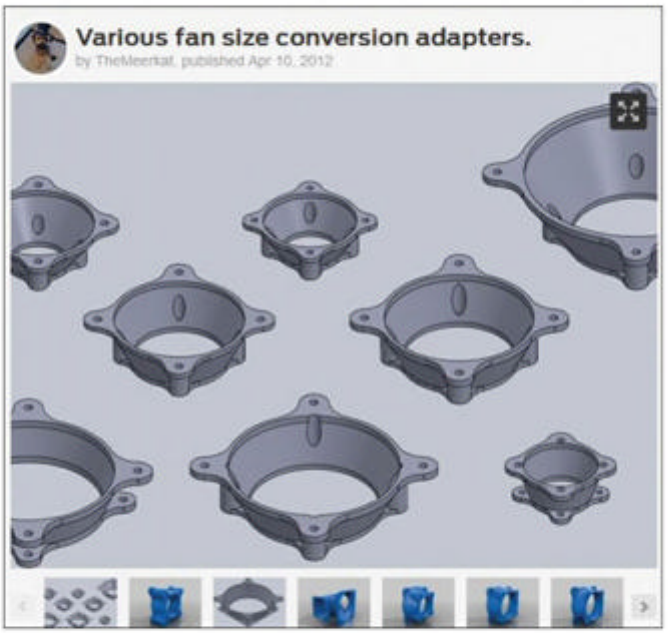
VALUE 21/30

OVERALL SCORE 84%

VERDICT

A fantastically easy-to-use 3D printer, but you pay a premium for it.

Hexagonal fill patterns take longer to print but offer stronger structures



A user called TheMeerKat on Thingyverse has created PC fan adaptors in various shapes and sizes

helps to prevent uneven cooling, while providing an adhesive surface to prevent the object moving during the print. On the Cube 3 printer we're using in this feature, you use a tacky glue that secures the object's base to the printing surface – you can then clean off the glue afterwards.

How much does it cost?

As we've previously mentioned, the cost of printing your object varies greatly depending on the design. If you're going to be printing a lot of objects then it's worth considering the power draw of the printer too – plastic extrusion printers need to heat the plastic, and most medium to large objects take hours to print too. However, the key to keeping costs (and indeed print times) to a minimum is largely down to the amount of plastic you use.

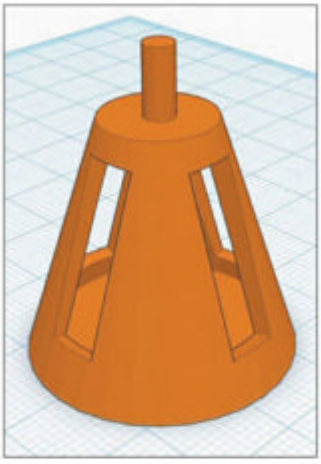
As a result, if there are any locations where you can create spaces or gaps in your designs, rather than needlessly filling in unseen space, you should take every chance to do so, even if it means spending a little more time rendering them. For instance, if you're printing a cube-shaped object, don't fill in the entire cube, but create a hole in the middle. In TinkerCad, you can simply create a slightly smaller version of the cube, insert the shape into the centre of the original render, and then convert it to a hole.

For this reason, though, it can be quite tricky to work out exactly how much an object will cost to print. Cold, hard numbers point to a rough figure of 1cm³ of PLA or ABS plastic costing 5-10p, assuming you're using a standard 1kg spool of plastic filament. However, there are exceptions to this costing rule, such as the Cube 3 printer reviewed in this feature, which uses more expensive proprietary cartridges, rather than standard filament spools.

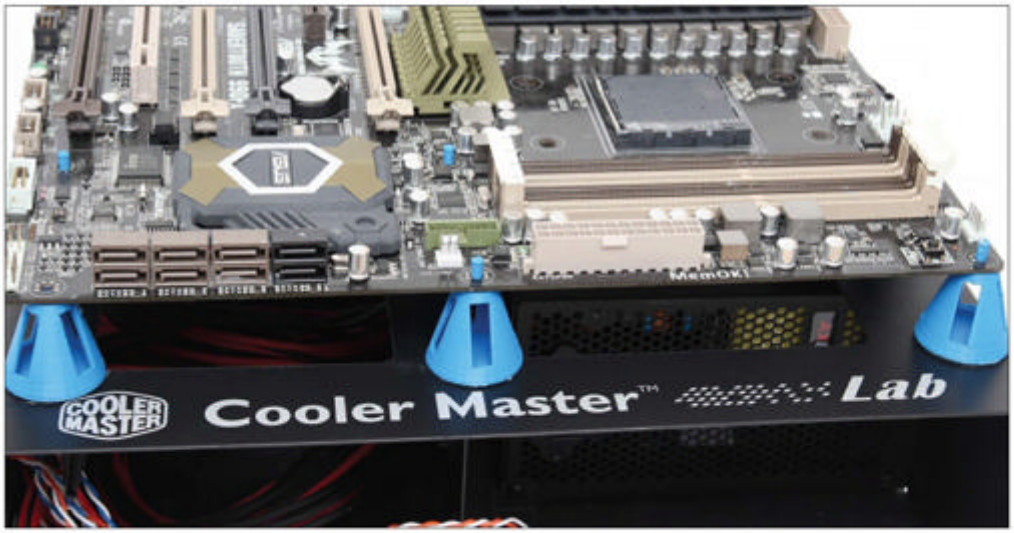
Printing custom PC parts

So now you know how to design, upload and print your objects, what exactly can you print for your PC? In this month's How to guide (see p102), we've made a 140mm fan grille, but the possibilities are endless. It would be just as easy to make a an SSD holder, water-cooling pump or radiator mount – in the guide, you can see the sheer ease with which you can create any kind of object.

It's easier to print ready-made designs, and there are many on Thingyverse. A quick search revealed fan adaptors that allow you to use 120mm fans in 80mm fan mounts, for example, along with drive adaptors, case feet and even motherboard supports for out-of-case testing and mounting motherboards in scratch-built cases. CPC



Create holes in objects wherever possible to reduce material costs, as we did with this motherboard standoff mount

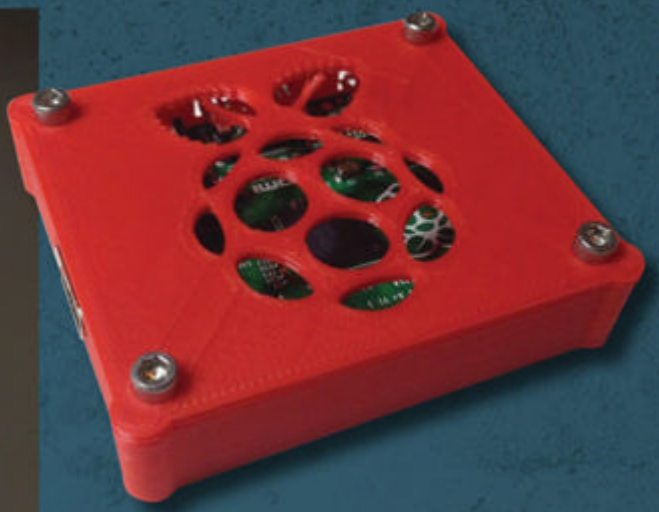


You can even print motherboard supports for out-of-case testing and mounting motherboards in scratch-built cases

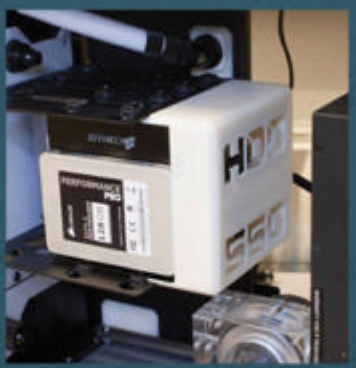
SHOWCASE

WE TAKE A LOOK AT SOME OF THE UNIQUE COMPUTER MODDING PROJECTS THAT HAVE MADE GOOD USE OF 3D PRINTING

The winning entry to bit-tech's Intel NUC case design competition last year was made by Alex Banks, who will also feature in Readers' Drives next month. Called Vesper, Alex used 3D printing company www.digits2widgets.com to print the case in nylon using an SLS printer



Raspberry Pi cases are very popular subjects for 3D printing, and it's even possible to design and print cases for Intel's NUC motherboards too



One of our previous Readers' Drives subjects, M8 by Hans Peder Sahl showed other uses of 3D printing when it comes to PC modding. Hans Peder used a 3D printer to create a custom mount for an SSD rack, a power switch and numerous component covers. However, the most elaborate use of 3D printing in the project was to create the cable covers for the graphics card and motherboard

GARETH HALFACREE'S

Hobby tech

The latest tips, tricks and news in the world of computer hobbyism, from Raspberry Pi, Arduino and Android to retro computing

INTERVIEW
York Hackspace Spacehack

Last year, I attended a neat little maker-themed event at the National Media Museum in Bradford where I bumped into Bob Stone, an enthusiastic member of York Hackspace (**http://york.hackspace.org.uk**) who was showing off an incredible creation: Spacehack.

'Spacehack is a fast, fun and frantic cooperative starship emergency drill game by York Hackspace, involving control panels, teamwork, shouting, stress and inevitable destruction,' he explained. 'Set aboard the perpetually disaster-prone USS Guppy, crew must operate their command consoles to flip switches, turn dials, push buttons and more according to instructions relayed by their comrades – but how long can they keep the ship safe?'

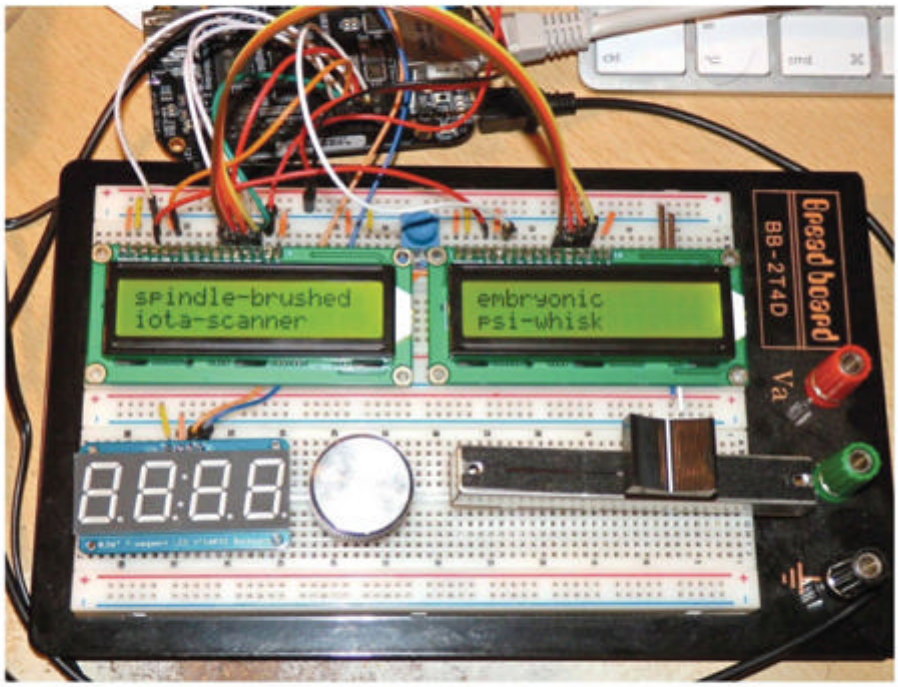
The game was physically instantiated as two or more control panels linked to a central hub, and it certainly drew a crowd. Players take a station, which randomly reconfigures the names of its various controls. An instruction then appears, which will either be for a control on the player's panel or on another panel – meaning that you frequently have to shout instructions to the other player, often while they're shouting instructions to you. Chaotic, yes – but also great fun.

Bob Stone, rear left, built the Spacehack with other members of York Hackspace as a demonstration piece for Maker Faire

'We were actively looking for a group project to build at the Hackspace, which we could use as our debut exhibit at the UK Maker Faire in Newcastle,' Stone told me of the project's origins. 'We wanted to make something hands-on for the public to interact and play with, rather than just bring in an assortment of stuff we'd made for folks to passively look at.

'After one of our number introduced the group to the phenomenally brilliant mobile phone game Spaceteam, by Henry Smith, we knew it would make a wonderful project to reimagine for the real physical world. We weren't the first to do so, or even the best, but I think our game captures the distilled essence of starship red alert panic most efficiently.'

The system runs from a device that should be familiar to readers of this column. 'We have a central ship's computer housed in a lovely gold brick, which is powered by a neurolysed



An early prototype proved that the Beaglebone Black was up to the job of running each control pod

The game is sure to draw a crowd, even when running in a cut-down two-player configuration

positronic net suspended in quantum warp plasma, but when that arrived from China, it turned out to be just a bag of mislabelled pork scratchings,' Stone joked, 'so we fell back on plan B, which was a Raspberry Pi running Python, as all good plan Bs usually are.' The Pi runs the whole game from this central server box, which also contains networking and power management for the player consoles – these are essentially custom dumb terminals attached to the game intranet.

All game text, states, scores and sounds are handled by the Raspberry Pi, which tells each player console what text to write on which of its seven LCDs, which LEDs to light up in what colour, and receives notifications from the consoles about user interactions such as button pushes, switch flips, control knob rotations and so on.

'The consoles need a large amount of I/O to work, and also need to be networked to the server Pi and be able to process complex communication to and from the server,' says Stone, 'so we chose Beaglebone Black controllers, which are similar in many ways to the Pi but with a huge number of I/O pins on board. Like the Pis, they're little Linux boards on which we run the client code in Python, communicating bidirectionally with the server

'We chose Beaglebone Black controllers, which are similar in many ways to the Pi'

The finished pods use laser-cut and 3D-printed parts, along with a full-colour overlay

using the MQTT publish/subscribe protocol, and passing messages encoded with JSON.

'We made the consoles using laser-cut sheets of acrylic and plywood for the main top layer, sandwiching a printed paper graphics sheet, bolted to a wooden desk-shaped frame for the main box.

'Sitting on top are 3D-printed instructions and status pods housing a 20 x 4 character display and LED matrix.'

The platform is extensible too: it launched at the Maker Faire in Newcastle with three console pods, while four have been constructed so far. Having played it with two, I can only imagine how frenetic the game becomes with four players shouting over each other and trying to avert catastrophe.

Naturally, it's also open source. 'Everything for it is available on our York Hackspace GitHub account, including drivers for hardware we had to port for Beaglebones when we couldn't find what we needed. Our repositories include not only the game code in Python, but also the 2D designs for the laser-cut tops and the 3D designs for the instructions pods. You can build your own version of the game if you have a spare weekend,' Stone said, before adding 'and then another spare few months.'

Full details of the project are available at **http://spacehack.york.hackspace.org.uk**, with code and design file downloads on **https://github.com/yorkhackspace/ConsoleGame**. You should also be able to find assistance at your own local Hackspace.

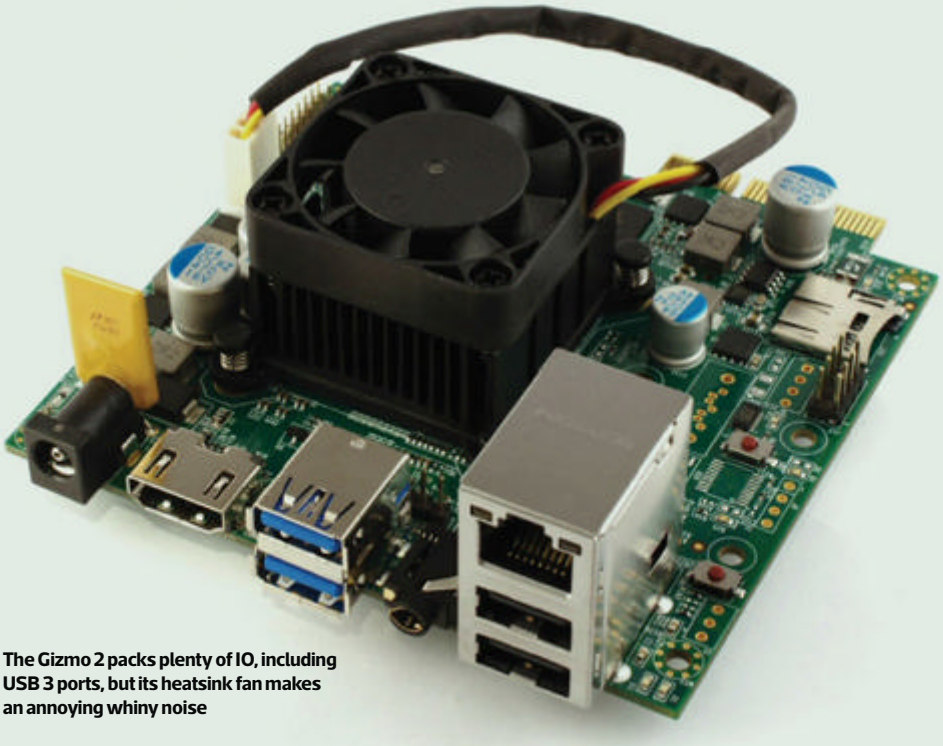
REVIEW

Gizmo 2

To say the world of hobbyist-orientated, single-board computers is monopolised by ARM's multitudinous licensees is no exaggeration: from the freshly announced Raspberry Pi 2 through to the Nvidia Jetson TK1, the overwhelming majority of boards use a variant of the ARM architecture for their processor. The majority, but not all; the Gizmo Explorer Kit, an open-hardware creation built in partnership with AMD, was one famous exception that has now received an update.

The first factor to note about the Gizmo 2 is that it no longer comes as a bundle package. The original Gizmo board was available exclusively as a kit put together by embedded development expert Sage Electronics. Buyers got a prototyping board that connected to a low-speed expansion header, and a time-limited JTAG debugger probe hat required registration to use beyond the first 24 hours.

The Gizmo 2, by contrast, is sold solus, packaged with nothing more than a power supply, a 4GB micro-SD card with the OS pre-loaded and a battery for the handy on-board real-time clock. Buyers also get a surprisingly bulky heatsink pre-applied to the board, featuring one of the less welcome changes from the original model: an annoyingly whiny cooling fan.



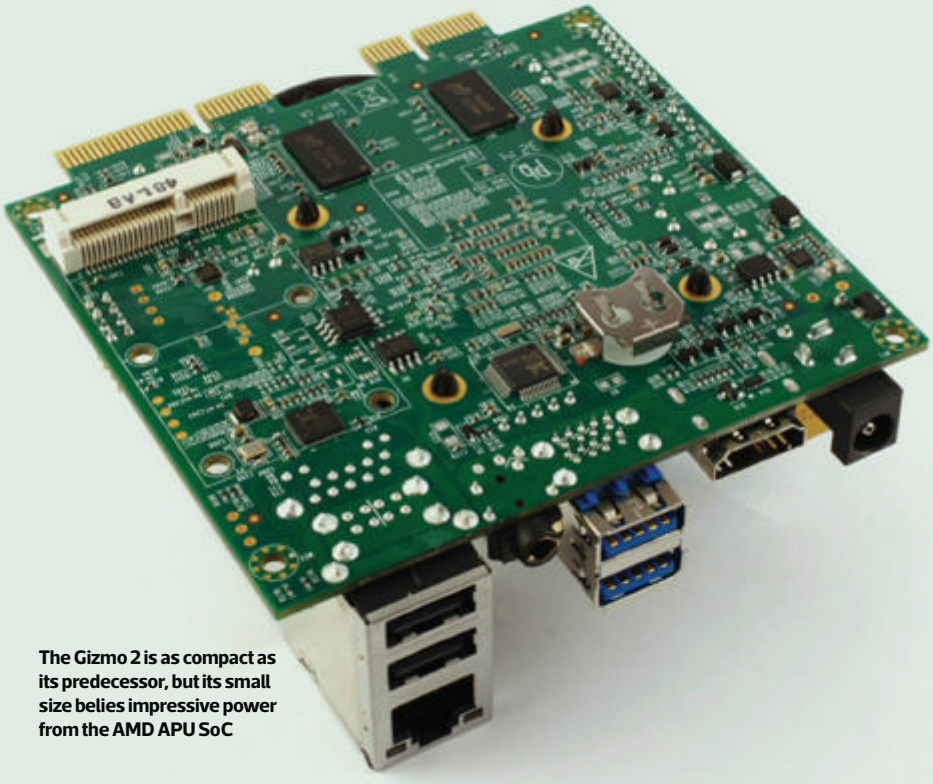
The Gizmo 2 packs plenty of IO, including USB 3 ports, but its heatsink fan makes an annoying whiny noise

The fan is there to cool the new system-on-chip processor, AMD's dual-core 64-bit GX-210HA running at 1GHz. The chip has a 9W thermal design profile (TDP), and includes integrated Radeon HD 8210E graphics hardware with a promised 85 gigaflops of compute performance, and it's clear that the Gizmo 2's designers didn't want to take the risk of passive cooling.

The use of an industry-standard AMD64 x86 chip means the Gizmo 2 also has compatibility its ARM-based rivals can't match. Although I used Ubuntu 14.10 for testing, any standard operating system should, in theory, boot on the system – including Windows 8.1 and the upcoming Windows 10.

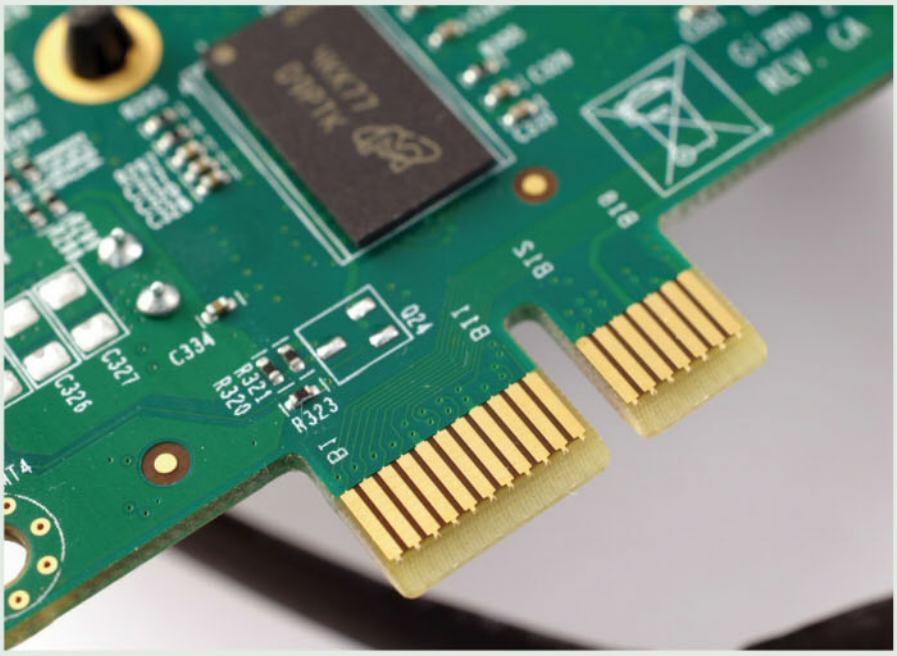
The 9W SoC also packs a heck of a punch: single-threaded SysBench performance hit a 95th percentile time of 2.08ms, a significant improvement on the 9.87ms of the original Gizmo and even faster than Nvidia's impressive Tegra K1's time of 7.31ms. Network throughput too is desktop-class at 896Mb/sec – a breath of fresh air after the usual disappointment of 'Gigabit' Ethernet ports on ARM-based SBCs hitting highs of around 600Mb/sec at best.

Naturally, the Gizmo 2's main selling point as a development board is its connections. The usual ports are present and correct – a 12V power input, two USB 3 and two USB 2 ports with a further pair available via an on-board header, an HDMI port, analogue audio, Gigabit Ethernet and a micro-SD port for storage – along with the same high and low-speed connectors as its predecessor.



The Gizmo 2 is as compact as its predecessor, but its small size belies impressive power from the AMD APU SoC

The original Gizmo's SATA port has been replaced by an mSATA-compatible mini-PCI-E slot



High-speed and low-speed edge connectors are provided for hardware interfacing, but making use of them is awkward for hobbyists

These edge connectors are designed to mate with PCI-E (in terms of shape rather than function) slots on add-on modules, and carry signals ranging from GPIO and SPI all the way through to SATA and USB 3. Without the Explorer board of the original Gizmo bundle, however, using even the low-speed signals from these connectors is a pain for hobbyists, and near-impossible without buying or building your own break-out board.

Another change from the original design is the removal of the SATA connector, although a SATA 2 signal is still present on the high-speed connector.

In its place, the Gizmo 2 has an mSATA-compatible mini PCI-E slot on the underside of the board, with screw points for half and full-length cards.

There are a few niggles to be found with the Gizmo 2, though, sadly. The board uses a cut-down SeaBios, which caused a few issues during testing: an Ubuntu Live USB drive would failed to boot until I manually intervened to bypass the graphical menu and load the installer manually, while a USB storage device with a copy of Ubuntu installed on it would boot from the slower USB 2 ports but not the high-speed USB 3 ports –

The AMD SoC includes integrated Radeon HD 8210E graphics hardware

an issue I was actively investigating with the GizmoSphere team but had not yet resolved at the time of writing.

The Gizmo 2, then, is an odd duck. It's more expensive than rival desktop-class compact computing devices, such as Intel's NUC, but with slower performance, and it's less friendly to hobbyists than low-cost devices such as the Raspberry Pi.

For people willing to take the time, however, or who need that rare combination of GPIO capabilities and Windows compatibility, it has plenty to offer – but don't sit it right next to your desk, like I did, as that fan is truly annoying.

The Gizmo 2 is available from **http://uk.farnell.com** for £149.26 inc VAT.

NEWS IN BRIEF

Raspberry Pi 2 launched

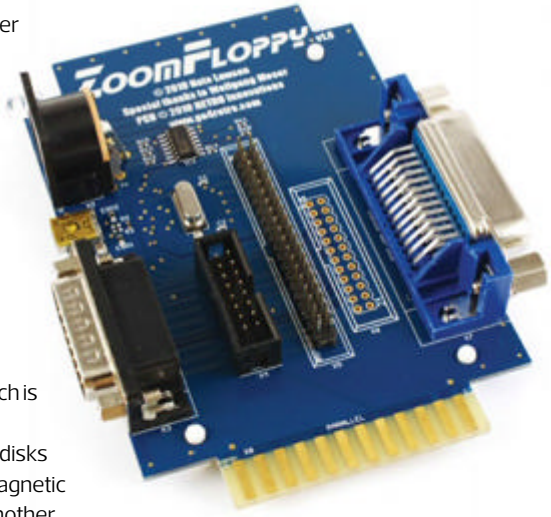
The Raspberry Pi Foundation has officially launched the Raspberry Pi 2, and while it looks at first glance identical to the Raspberry Pi Model B+, there's a significant change under the hood: a switch to a quad-core 900MHz ARMv7 BCM2836 system-on-chip processor. The new microarchitecture, as well as boosting performance, increases the device's compatibility with newer operating systems. Canonical has released a build of its Ubuntu Snappy Core for the board, while Microsoft – in a surprise move – has announced that all Raspberry Pi 2 owners will get a free embedded version of Windows 10 aimed at Internet of Things (IoT) development. Expect a full review and feature in the next issue of **Custom PC**.

VINTAGE
ZoomFloppy

Regular readers may remember my review of the Software Preservation Society's excellent KryoFlux from Issue 131. If not, here's a recap: the KryoFlux sits between a classic floppy drive and a PC's USB port, and allows accurate images of any disk – even unknown formats – to be stored for analysis. It's an incredible piece of equipment, with one drawback: imaging double-sided Commodore 64/128 floppy disks requires a specially modified drive, which is hard to obtain and even harder to build.

As I have rather a lot of Commodore disks of an age where deterioration of the magnetic coating is a real concern, I sought out another solution and found it in the ZoomFloppy. Created by Nate Lawson as an implementation of the XUM1541 hardware framework, itself an update of the low-cost build-it-yourself XU1541, the ZoomFloppy is designed primarily to interface traditional Commodore floppy disk drives with a modern PC. That isn't its only talent, however: the ZoomFloppy, despite its name, is an entire modern recreation of Commodore's IEC serial communications protocol, which means it can drive any IEC device, from floppy drives to printers, plotters and even modems.

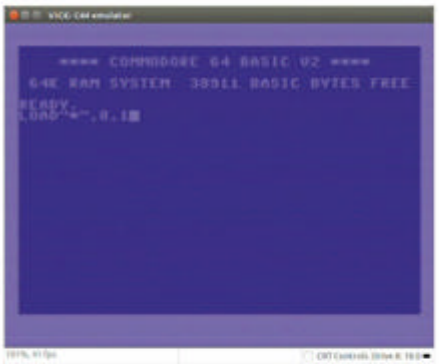
The heart of the ZoomFloppy is an Atmel ATmega32u2 microcontroller, located on the underside of the circuitboard. This part performs the logical leaps required to convert IEC communications to USB and vice versa,



The ZoomFloppy offers an easy way to control Commodore IEC or IEEE-488 devices, including floppy drives, from a USB port

and does so admirably: any device connected to the ZoomFloppy will run, at worst, exactly as fast as it would if it was connected to a real Commodore 64, and at best – such as with a 1571 disk drive modified for parallel data transfer – significantly faster.

The ZoomFloppy provides the hardware interface to IEC and (optionally) IEEE-488 devices, but you also need the software. OpenCBM, an open source project, allows Windows, Linux and OS X to communicate through the ZoomFloppy, and includes utilities that allow for a near-preservation-grade disk image to be captured from or written to a connected floppy. Unlike the KryoFlux, this



The ZoomFloppy can be connected to emulation software to provide direct control, loading even copy-protected disks with ease

procedure doesn't require a modified drive: any original Commodore disk drive will work fine, although a double-sided version is required to capture both sides in a single pass.

Where it gets clever is with OpenCBM's passthrough support for emulators. Loading up Vice on my Ubuntu 14.10 desktop, I could convince the emulator to communicate with devices connected to the ZoomFloppy, including my Commodore 1571 floppy drive. For anyone looking to create emulators based on low-power PC hardware, that's a major selling point: the ability to use original hardware with a non-original machine.

There are a few downsides to the ZoomFloppy, of course, as is frequently the case with these niche creations. The device isn't quite as plug-and-play as the KryoFlux, for a start, with Linux users having to download and compile the OpenCBM source code. Windows users, however, are given a modified version of OpenCBM for far quicker installation. It's also only available for import from the USA, bumping up the cost, although its starting price makes it a far cheaper alternative to the KryoFlux for anyone who already has a Commodore disk drive and doesn't need support for other disk formats.

The ZoomFloppy is available from **http://store.go4retro.com**, priced at $35 (£23) for the base model or $42 (£28) for the version with IEEE-488 connector as reviewed. Delivery should take no more than a week or so, but be aware that the cost is above the £15 import threshold, so customs clearance may result in VAT and a handling charge. CPC

NEWS IN BRIEF

CubieBoard 4 upgraded to v1.2

CubieTech has upgraded the CubieBoard 4, reviewed last month, to version 1.2, with UK distributor **www.newit.co.uk**, which was kind enough to send me an updated model. Compared with the v1.1 as reviewed, the new version includes a better push-pin heatsink, revised case with better clearance, a shifted antenna connector that no longer pushes against a case bolt, and a silk-screened quick-look-up table for the general-purpose input-output (GPIO) header directly on the PCB. All orders of the CubieBoard 4 should now result in a v1.2 being delivered.

Gareth Halfacree is the news reporter at www.bit-tech.net, and a keen computer hobbyist who likes to tinker with technology. @ghalfacree

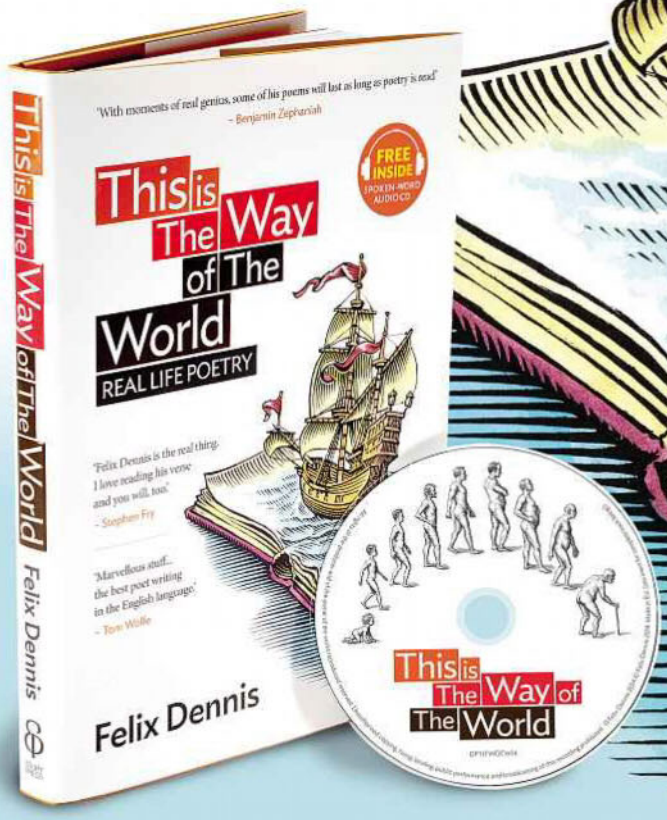
'With moments of real genius, some of his poems will last as long as poetry is read.'

– Benjamin Zephaniah

This is The Way of The World

Felix Dennis

RRP £12.99
AVAILABLE NOW FROM AMAZON AND ALL GOOD BOOKSELLERS



A book of poems for those who don't read poetry (as well as for those who do!)

A collection of 'real life' poems by Felix Dennis, one of Britain's best-loved poets, charting life's course from infant to endings with illustrations by Bill Sanderson.

www.felixdennis.com contains many poems, published and unpublished, as well as a library of sound recordings and video footage of Felix Dennis's verse and poetry tours.

EBURY PRESS

ANTONY LEATHER'S

Customised PC

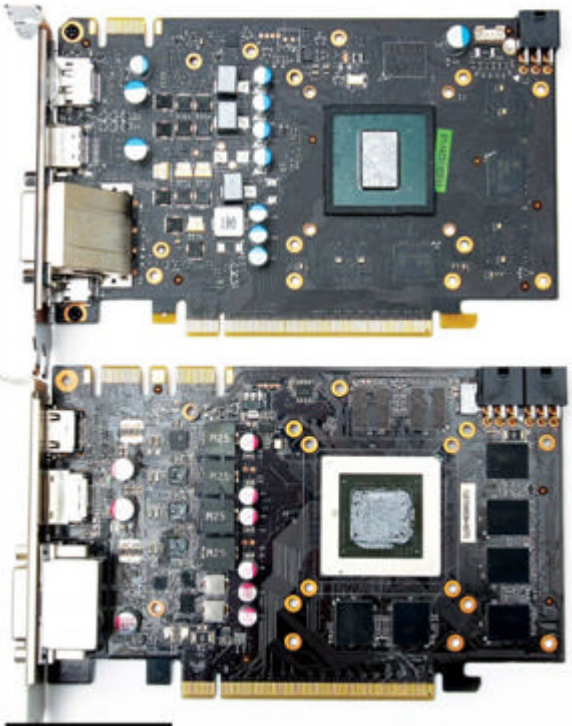
Case mods, tools, techniques, water-cooling gear and everything to do with PC modding

No full-cover GTX 960 waterblocks?

It's been a rollercoaster ride once again for water-cooling enthusiasts with the launch of numerous new GPUs from Nvidia, with the most recent chip being the cheaper GTX 960. However, because of the GTX 960's low TDP, and the fact that there are so many variations of the PCB (a common occurrence with many of Nvidia's mid-range graphics cards), it's unlikely that full-cover waterblocks will be available for it. The PCB situation plagued the GTX 970 too, with numerous models unlikely to be supported by the likes of EK Waterblocks. Sadly, the situation is so bad with the GTX 960 that EK has already stated categorically that it will not be producing full-cover waterblocks for the GTX 960.

I can understand its reasoning, but I would have liked to see just a couple of blocks produced for popular GTX 960 models, such as the Asus Strix or MSI Gaming cards, to give people the option, even if it's just so you can add the aesthetic value of water cooling to a GTX 960 system.

Thankfully, there are a couple of ways around this lack of waterblocks if you're dead-set on water-cooling a GTX 960 card. Universal waterblocks are available that can cool the GPU core, and as most GTX 960s don't actively cool many of the memory modules, slapping a few heatsinks on the exposed ones will mean this will work fine.



The GTX 960 (top) and GTX 660 Ti (bottom) are very similar indeed

As you can see from the photo, there isn't much difference between GTX 960 and GTX 660 Ti cards – there are just a few capacitors preventing full-cover GTX 660 Ti waterblocks fitting on a GTX 960 card. As such, another option is to modify an existing full-cover waterblock. Many waterblocks that are compatible with standard GTX 660 Ti and GTX 970 cards match up with the mounting holes on standard-length GTX 960s. However, there will likely be some capacitors in the way, so you'll have to cut a few small chunks out of the waterblock to make it fit.

In a future How to guide, I'll look at how to fit such a waterblock to a GTX 970 card. What's more, EK Waterblocks has also been kind enough to send me one of its latest Thermosphere universal core-only waterblocks, so I'll be showing you how to mount one of those too.

Hex Gear interview

I've known Hans Peder Sahl and Nate George for a few years in modding circles, and I was thrilled to see their new Hex Gear-branded R40 case appear, which they've designed and made themselves. I caught up with them to ask them a little more about it.

Antony: So Hans Peder, how did you get into PC modding?

Hans Peder: I started out playing with a bunch of materials, and it all took off from there. I really got into design work and spent time building my portfolio, and over the last few years I've made a few modding projects too. I then started an internship at SteelSeries, where I helped to design products and completed my bachelor project for my

Hex Gear's R40 case is available in a variety of colour schemes

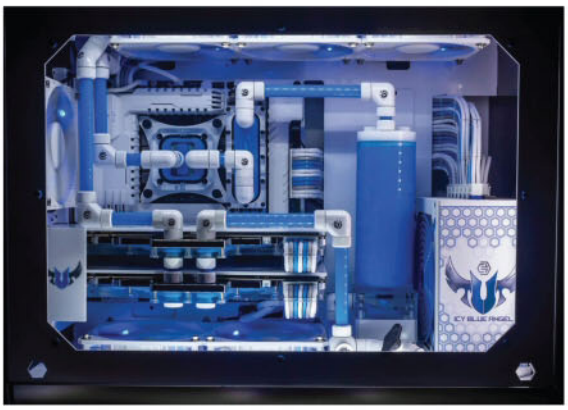
education. I now work at a company called BPI, designing high-end furniture. I also got into 3D printing at school where I was lucky enough to have access to a 3D printer, and I incorporated that into some of my projects too. I like using new technologies and ideas with my projects, and that's partly how the new case came about.

I've been designing and building stuff since I was around seven years old, starting with wood off-cuts I got cheaply and knocking parts together with nails. That continued until around 2009 when I needed a new PC but couldn't see any cases I liked, so I decided to build my own. I eventually started the modding store **www.e22.biz**, where I offer customisation not just for PC modding but all sorts of parts, as well as products I make, such as PSU cable combs. I now own a mass of power tools as well as a three-axis CNC machine and a laser cutter.

Antony: Which came first – Hex Gear or the R40?
Hans Peder: The case came first, although the early designs weren't great. Then Nate came up with the idea of using extruded aluminium profiles in the design. I then went dark (worked very hard, with minimal communication) for the next week or so, as this idea revolutionised the design and the way in which the case could fit together.
Nate: What he came up with is basically what you see today with the R40 – it's changed very little.

Antony: Who came up with the idea for the case?
Hans Peder: It came about through a conversation we were having. We both work hard, but I was especially looking for something different to do, so we both thought about what we could work on. We first thought about doing a one-off modding project, but then hit on the idea of making a case that would be widely available.

Antony: How long did it take to move from the idea to a physical product?
Nate: We started in May 2014, and soon afterwards, we were ready to tell a select group of modders (who would receive a case in order to promote it) that they'd have their cases by August. That didn't quite happen, but it took less than six months to progress from the design work to actually shipping the first few early samples.
Hans Peder: We put in a ridiculous amount of hours – my girlfriend hasn't been too happy recently!



Antony: Did you face any challenges getting the R40 built, and where is the final product actually constructed?
Nate: I make smaller products at the moment, but the case was a whole new ball game, especially as I started to work with companies abroad to get the parts made and shipped back to the UK.

Initially, we had everything made in the UK, but as the project progressed, we just couldn't afford the prices being charged, so since June we've been working with a Chinese company.

Antony: Why did you choose micro-ATX as a form factor?
Hans Peder: Micro-ATX has huge potential, because the majority of people use one graphics card, while a few use two cards – both of these setups can be used in a micro-ATX case, but so many people use a case that's too big for what they really need. You can still use water cooling in the R40 quite easily, but it has a small footprint.

Antony: Do you plan to make mini-ITX and ATX versions of the case?
Nate: It's no secret that we want to expand and make Hex Gear a well-known brand, but a lot depends on the success of the R40. So yes, in the future we'd like to offer mini-ITX and full-sized cases too.

Antony: When will the R40 be available, and is there any word on price?
Nate: We're aiming for a UK release in the first quarter of 2015 – we're working with UK retailers as well, but it will definitely be available from the Hex Gear website. We've worked hard to keep the price down, and we hope it will retail for less than £200 inc VAT.

Thanks to Hans Peder Sahl and Nate George for taking the time to talk to us about Hex Gear and the new R40 chassis. In the meantime, you can see the R40 in action in some of the pictures on this page, courtesy of a modder called snef from bit-tech's forums. You can see his project log at **http://tinyurl.com/snef-r40** CPC

Antony Leather is Custom PC's modding editor @antonyleather

How to Make a 3D-printable fan grille

Want to create a custom 3D-printable part for your PC, but don't know where to start? Antony Leather takes you through the process

TOTAL PROJECT TIME / 3-6 HOURS

While you can buy all sorts of custom bits for your PC these days, there are still some niche items that simply don't exist, or you might just want your own personally designed version of a standard component, rather than a generic fan grille or another mass-manufactured part. That's where 3D printing comes in. Whether you need a custom shroud to hide your PC's cables, or a logo-clad top for a waterblock, pump or CPU cooler, you can quite easily design one and then print it out.

As we discussed in our 3D printing guide (see p94), owning a 3D printer can open up a whole new world of designing and making products at home. However, don't worry if you don't have a 3D printer – there are plenty of online services where you can print out your parts for a small fee too. In this guide, we look at how to get to grips with one of the best and simplest 3D design programs – TinkerCad, and take you through creating a custom fan grille.

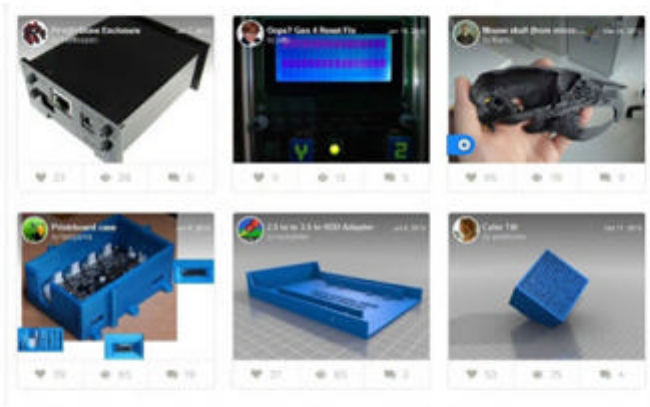
TOOLS YOU'LL NEED

TinkerCad / Free to use at www.tinkercad.com

3D printer or 3D printing service

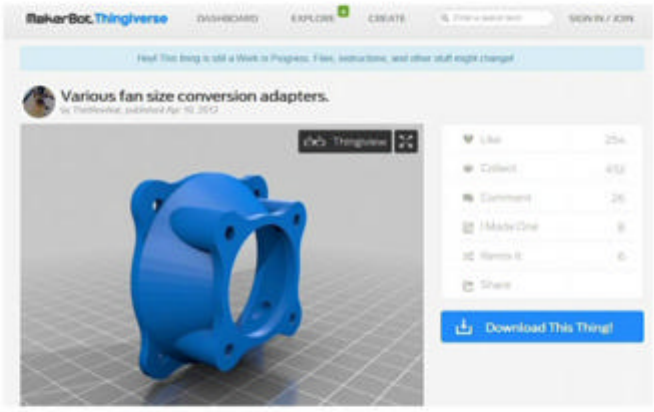
Micrometre / www.eBay.co.uk

Finger files / Most hardware stores



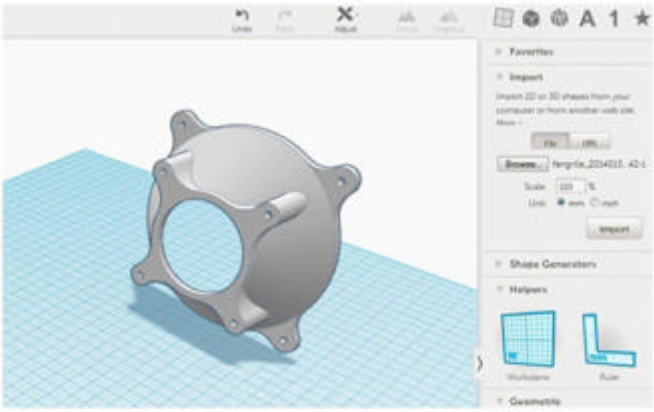
1 / DECIDE WHAT YOU WANT TO MAKE

There are plenty of PC-related objects you can make. Motherboard standoffs for custom test benches, fan grilles, lettering – designs are all available online, and of course, you can make your own object too. We advise starting with a simple project, and also factor in the costs involved.



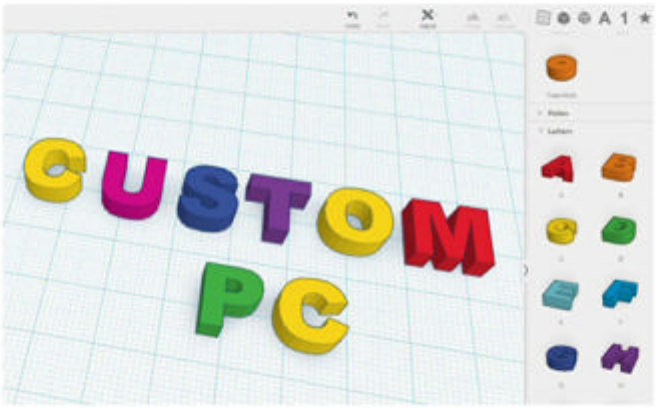
2 / SEARCH ONLINE DATABASES

There are some fantastic online databases of pre-rendered objects. A quick search on **www.thingyverse.com** reveals quite a few objects, such as fan adaptors, grilles and drive adaptors, so you might be able to find the exact part you need, or at least a design you can tweak to save time.



3 / IMPORT MODELS

To get a model from a website such as Thingyverse, click the download link on an object and select the STL file. You can then head into your 3D printer's program and print it directly, send it to a 3D printing service or upload it to TinkerCad to make your own changes.



4 / USE SHAPES AND SYMBOLS

TinkerCad offers a variety of pre-defined shapes, symbols and letters that are ready to print, and you can modify them in three dimensions to within 0.1mm accuracy. Drag objects from the right panel into the workplane. You can then rotate and resize them, using the displayed dimensions.

5 / MEASURE FAN DIMENSIONS

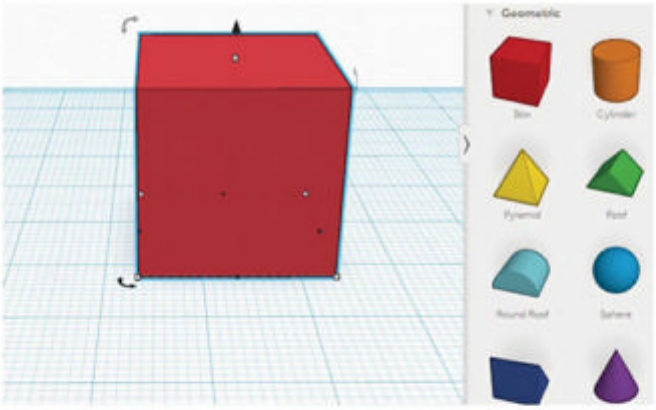
We'll be creating a 140mm fan grille, so we started by measuring the dimensions needed to cover the fan. As you can create objects down to 0.1mm resolution, it's worth using a micrometre to get accurate measurements.

6 / MEASURE HOLE SIZE AND LOCATION

The trick with a fan grille is to get the screw holes located in the right place. Measure the distance from the edge of the fan to the edge of the hole on each side of the fan, as well as the diameter of the hole itself.

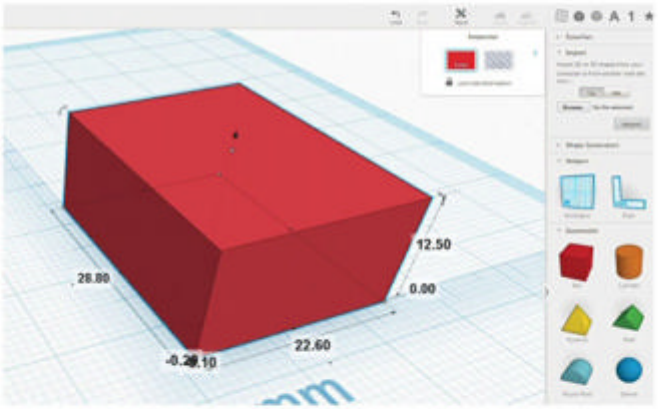
7 / MEASURE DISTANCE BETWEEN HOLES

The all-important measurement is the distance between the holes themselves. Getting this measurement right will enable you to align all four holes so they marry up with the fan once the grille is printed. The distance should be the same between each of the four holes, end to end.



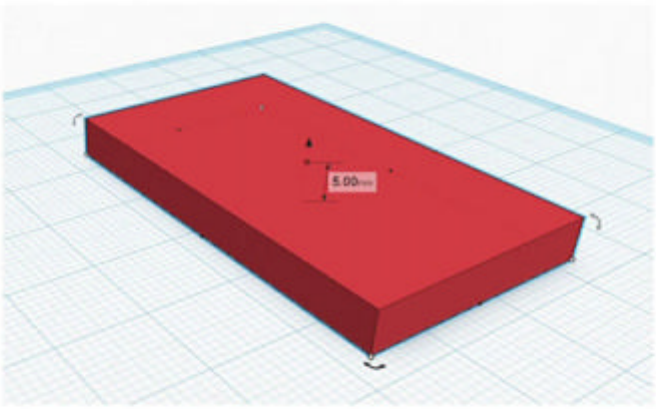
8 / CREATE BASE OBJECT

To create objects in TinkerCad, you start with a base object. You place other objects into this base object to add parts to it or even to create holes in it, which we'll get to in a minute. Select the box from the Geometric shape selection and drag it into the workplane.



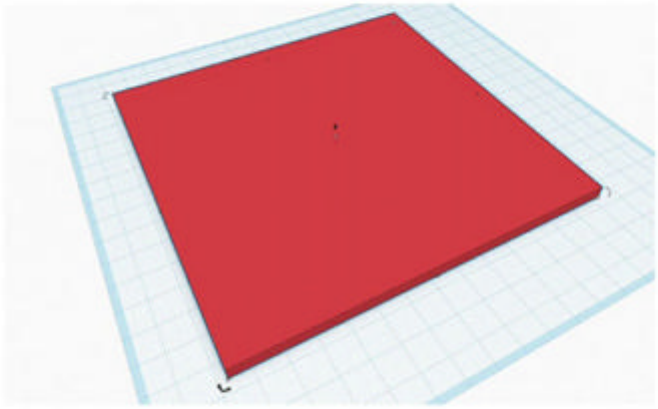
9 / USE THE RULER

You can drag the ruler into the image to measure the distance between two points. This tool can help line up parts, although as you create the base you'll be given real-time measurements while you manipulate it anyway.



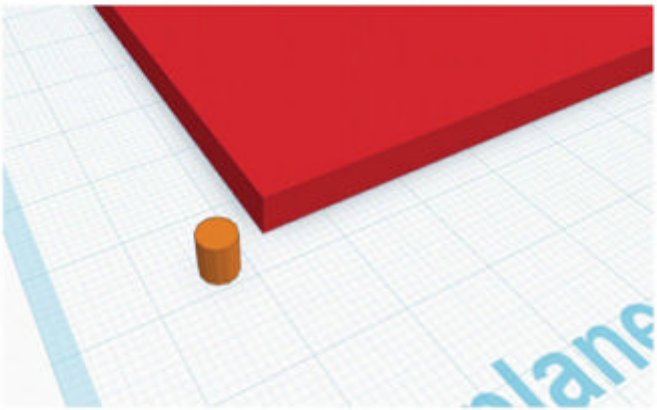
10 / REDUCE HEIGHT

Click on the object, then use the right mouse button, scroll-wheel button and scroll wheel to respectively drag, pan and zoom the workplane to 45 degrees from vertical. In the centre, you'll see a small square with an arrow pointing upwards, which you can drag to reduce the height. We decided on 5mm.



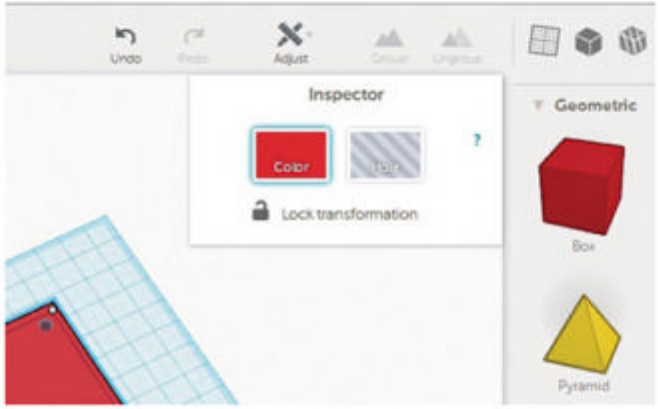
11 / SET WIDTH AND DEPTH

Now reduce the width and depth. We chose 139.6mm, which was the reading given by our micrometre. Again, move the view so you can see the other squares on the sides of the object, then move them until the object is the right size.



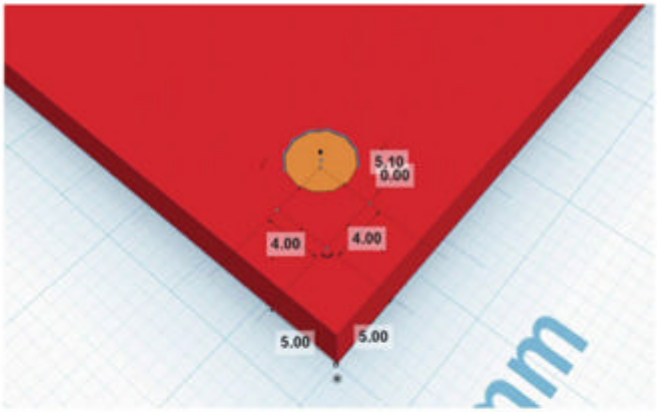
12 / CREATE CYLINDERS

To create holes in an object, you need to create an object the same size as the hole you want first. The fan screws we're using have a thread diameter of 4mm, so drag a cylinder into the object and resize it so that it's the same height as your fan grille and 4mm wide all the way around.



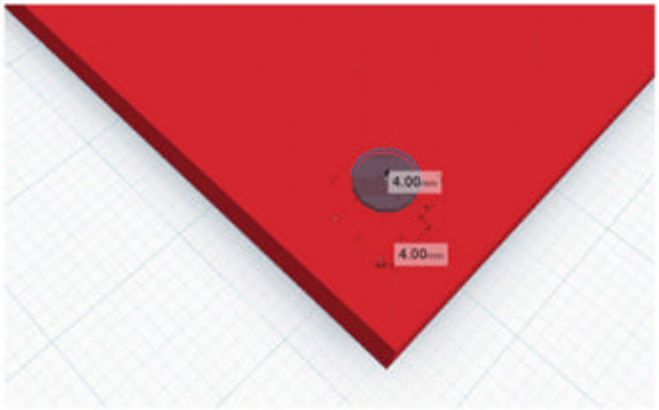
13 / MOVE CYLINDERS TO CORRECT LOCATIONS

To save creating four cylinders, just select the first one, then copy and paste three more. Move them into the right locations. As you can see, we've placed ours 5mm from either edge of the fan grille and also checked that the distance between them is correct too.



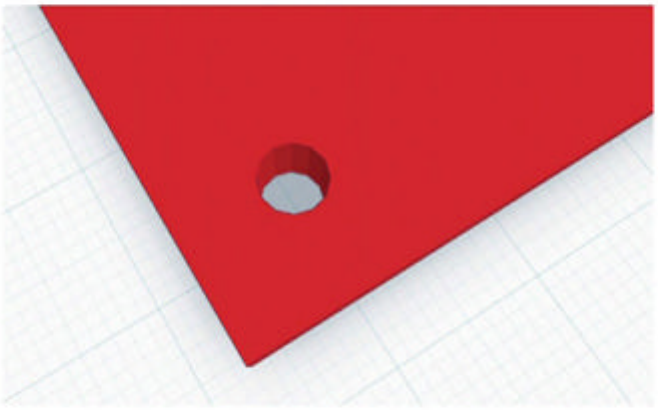
14 / CONVERT CYLINDERS TO HOLES

Once you've aligned all the cylinders, it's time to turn them into holes for the fan screws. Select all the cylinders by holding down Ctrl. An Inspector box will then pop up where you can select the Hole option. The cylinders will turn grey, indicating that they're now empty shapes.



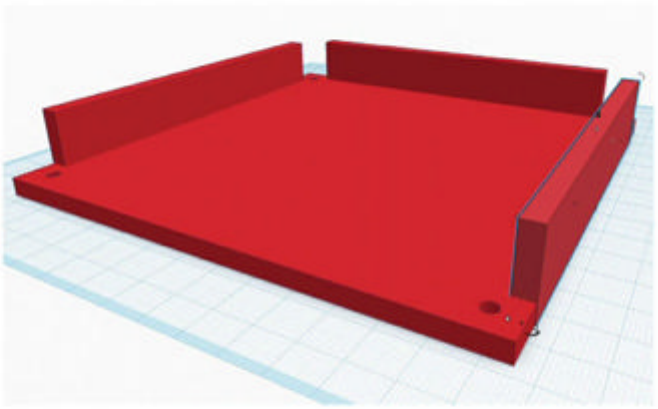
15 / GROUP OBJECT

To create the holes, you need to merge all the objects into one. To start, select the entire shape, including the cylinders you just converted to holes. After that, select the Group button from at the top menu bar.



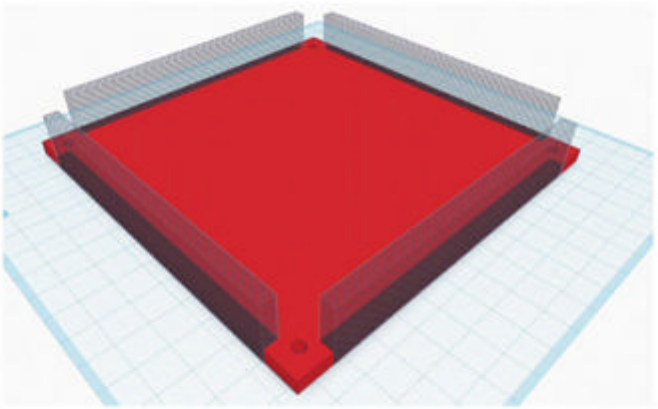
16 / CHECK HOLES ARE PRESENT

Once you've clicked the Group button, you should just be left with the fan grille, but now with holes in it. Check that all four holes are present, and that you can see all the way through the fan grille.



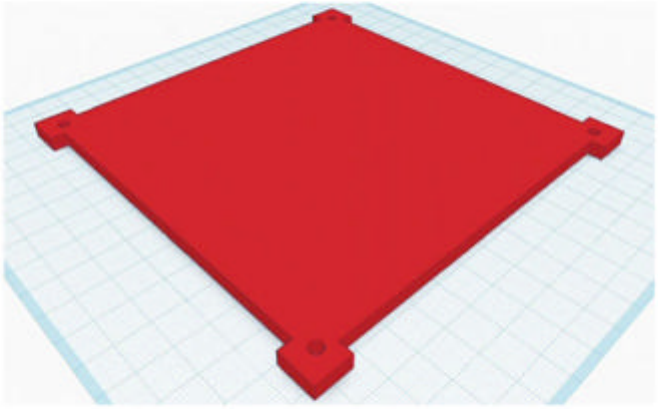
17 / CREATE EDGE DESIGNS

Using the same method employed to create the fan holes, you can also cut out the fan grille and vents in the grille itself. We've added insets at the edges by creating long rectangles that leave four protruding arms next to the fan holes.



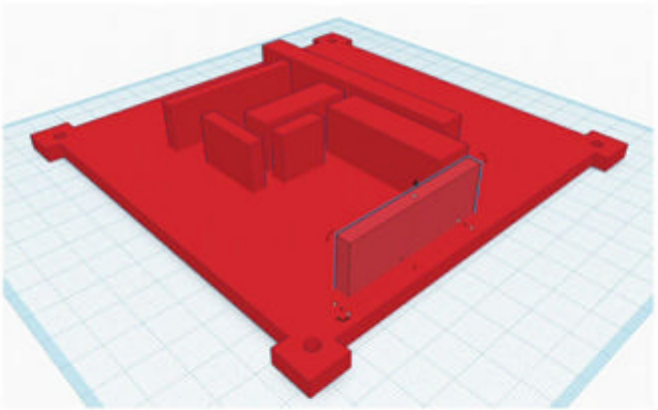
18 / CHANGE EDGES TO HOLES

Once you've dropped the rectangles or other shapes into the fan's border, select the shapes, then use the same method we used for the screw holes, and change them to holes using the top menu. Again, they will become grey or transparent.



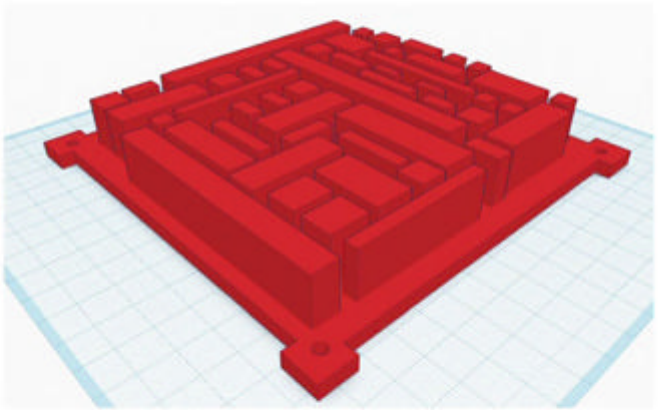
19 / GROUP OBJECT

Once the shapes have been converted to holes, select the entire object so that you can go ahead and click the Group button to set the holes in place. Once you've performed that task, the frame of the fan grille should look like the above picture.



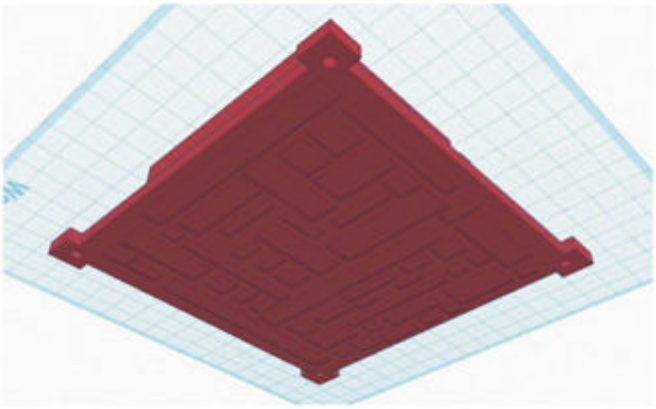
20 / CREATE INNER FAN GRILLE DESIGN

You can now create your grille design. Our own irregular square and rectangle design is fairly easy to make. We just created several types and sizes of objects using the Box tool, copied and pasted them, then rotated each of them so they all lined up before inserting them at random places.



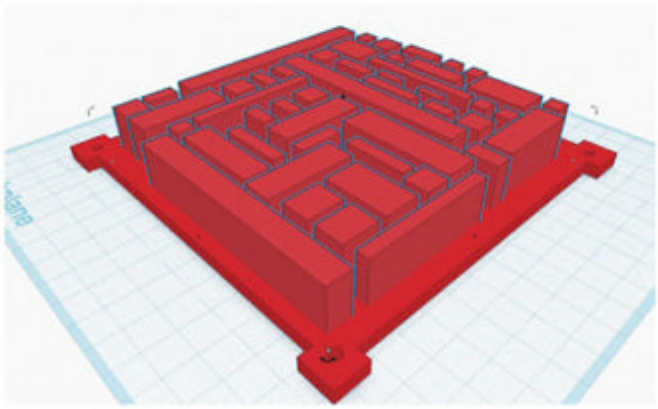
21 / BUILD DESIGN UP TO EDGE

In order for the fan grille to serve its purpose, and actually let air through it, you'll need to add as many objects as possible, which will also reduce the cost, but you also need balance the design so it doesn't become too fragile.



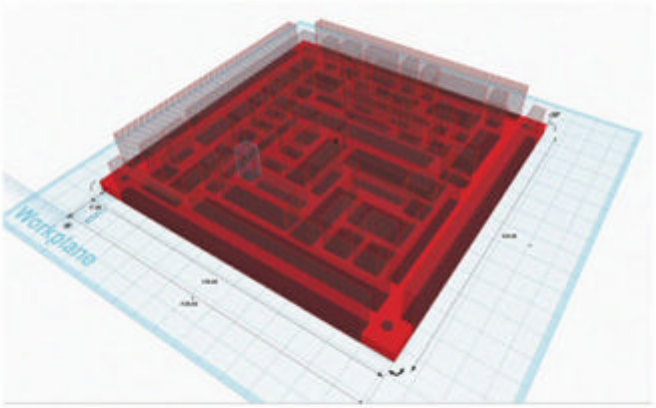
22 / CHECK OBJECT BASE

Once you've finished your design, check that all the objects have been placed so they meet the bottom of the workplane – by looking underneath, you'll be able to see the complete design.



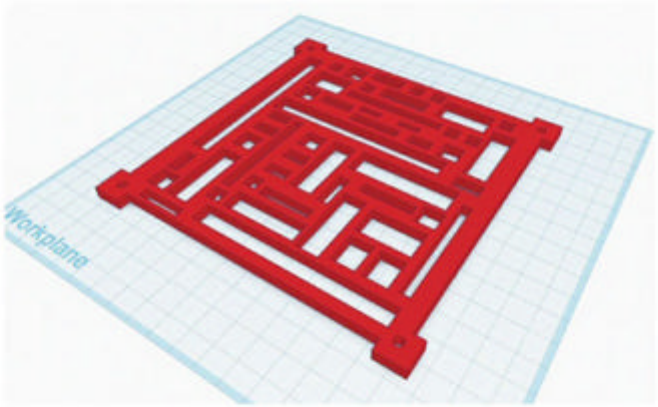
23 / SELECT OBJECTS

You can now select all the objects you've just added. The easiest way to do this job with lots of objects is to look at the design horizontally, and select the pieces all in one go. For this reason, it's best to make them noticeably taller than the fan grille.



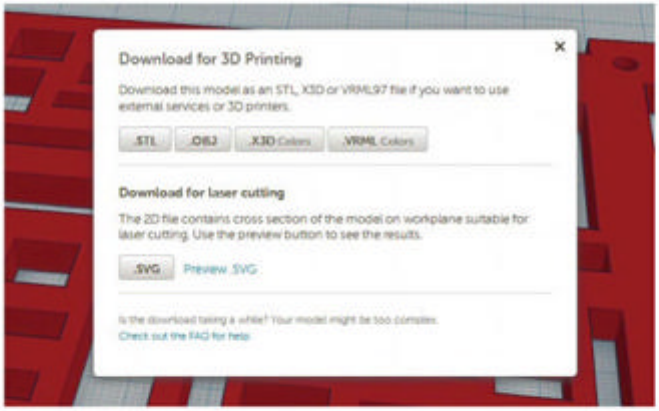
24 / SWITCH TO HOLE

Using the top menu, you'll now be able to convert your fan vent shapes into holes. Once that's done, they should turn transparent as shown. Don't worry if you missed any – you can now select any stragglers individually and convert them to holes too.



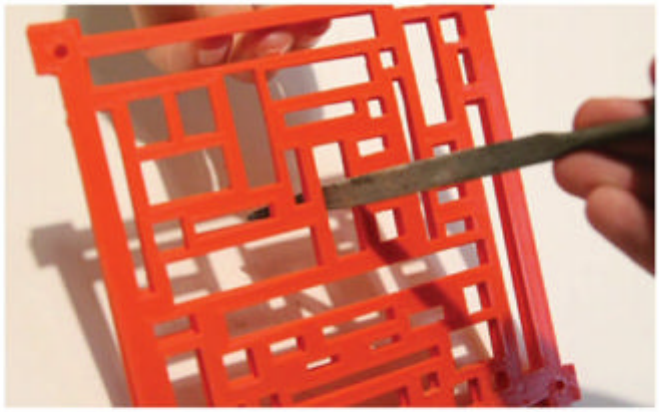
25 / GROUP OBJECT

With all the necessary pieces converted to holes, you can now select the Group button to set them in place. Your fan grille should look like the above picture, and will now be ready to print. Even at this stage, however, you can still alter the size and width of the fan grille.



26 / SAVE FOR 3D PRINTING

TinkerCad allows you to save your design for use in various programs – even Minecraft. However, we'll be needing the 3D printing option, which you can find in the top menu by clicking on Design and then Download for 3D Printing. You then need to save your project as an STL file.



27 / UPLOAD TO 3D PRINTER

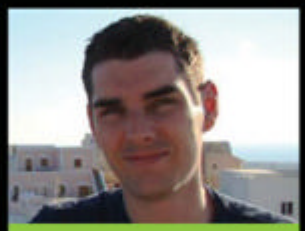
You can now transfer the design to your 3D printer, or send it to a third-party printing service. You may also need to file some of the edges if you've printed it yourself, as there can be stray material left over from the printing process. CPC


bitgamer
www.bit-gamer.net
YOU'VE GOT THE HARDWARE,
NOW FIND OUT HOW TO USE IT
N7
XBOX 360 • PLAYSTATION 3 • PC • HANDHELDS

Readers' Drives

Monolith

After making several hand-built mods, Justin Ohlsen learned how to use a CAD program so he could get CNC-milled parts for this sinister-looking SLI rig



/MEET THY MAKER

Name Justin Ohlsen

Age 28

Location Stockholm, Sweden, although I'm Australian

Occupation Light, sound and AV technician

Main uses for PC Designing new projects and occasional gaming

Likes New technology, designing, modding, chocolate

Dislikes Time wasters, people walking slowly while reading, sunburn

CPC: What originally inspired you to build Monolith?

Justin: I've always been in love with the SilverStone Fortress FT03 for its quirky design and layout, so I'd been dreaming of what I could do with this chassis for months before I bought it.

The inspiration actually came from all of my modding idols who have built super-stylish and clean-looking PCs. I wanted a build that was water-cooled, able to run a dual GPU setup and could be overclocked, which made me think about external water cooling. I wanted the radiator integrated into the design so that it seemed to be part of the chassis itself. I then had to think about the water-cooling loop – I would have to run my tubing vertically so the coolant would reach the radiator. I fell in love with Mayhems Raspberry Purple after a fellow modder had used it, and wanted to feature it in this project, so purple and black became a theme.

CPC: Where does the name come from?

Justin: I'd heard the word 'monolith' in an advert for a Sony LED TV. The panel had no bezel, and a single glass panel. The word stuck in my mind, and I associated it with clean and stylish design. I did a quick online search and found that the definition of the word suited the design goal I thought I had achieved, being an object with 'a uniform, massive, redoubtable, or inflexible quality or character'.

CPC: What specs did you choose, and why?

Justin: The original purpose of this project was to fill time, as there had been a delay with another project that was ongoing at the time. I'd been told that the parts would take a long time to come, and I didn't feel like waiting to complete a project. I also had the modding itch to replace my personal everyday PC, so I started designing right away.

This new project would include a stylish and simple design, water cooling for all the components and a general parts upgrade, so I could play the latest games at higher resolutions and frame rates. It also wanted to speed up the rendering time for when I was designing new projects. I upgraded from the Z77 platform with a Core i5-2500K to a Z87 Asus Gryphon motherboard and a Core i7-4770K. I also bought another GTX 780 so that I could enable SLI, and then run my favourite games at 2,560 x 1,440 at over 60fps.

CPC: What other PC mods have you built?

Justin: I've built six major modded PCs, but I've built around ten machines in total for my family and friends in the past two years. Before I built my first PC, I'd always been a console gamer, but now I'll never turn back. The projects for which I've created build logs have been for gaming and rendering. A few of the others I've built were just budget HTPC builds, or general web-surfing machines.

CPC: What difficulties did you come across?

Justin: I didn't have too many difficulties, thankfully. I'd taken the time to model and render the build to the nearest millimetre, so I could cut all the panels and so on almost perfectly the first time. I wanted to have a bunch of panels CNC-milled by a start-up company, which had requested that I send a specific type of file, as the people there couldn't model what I wanted for me in their CAD program. So I learned how to use Autodesk Inventor and Solidworks to provide the files.

One area that was more time-consuming, rather than difficult, was cutting areas from 4mm-thick aluminium U-channel. This U-channel was used to attach the radiator to the back panel of the FT03 chassis. I needed to cut away areas from the U-channel so that the dual 180mm fans wouldn't get blocked, and could push the maximum amount of air through the radiator.

SEE THE FULL PROJECT LOG: http://tinyurl.com/MonolithMod

Lastly, another tedious job was filling the loop. As the pump was integrated into the CPU block, and both the inlet and outlet were vertically routed to the roof, it was hard to have the pump always primed with coolant.

In addition, trying to get the air out of the system was a nightmare, which required me to employ the 'filling the loop dance'. My neighbours would probably think I was doing the tango with my

SYSTEM SPECS

CPU Intel Core i7-4770K

Graphics card 2 x Nvidia GeForce GTX 780

Case SilverStone Fortress FT03

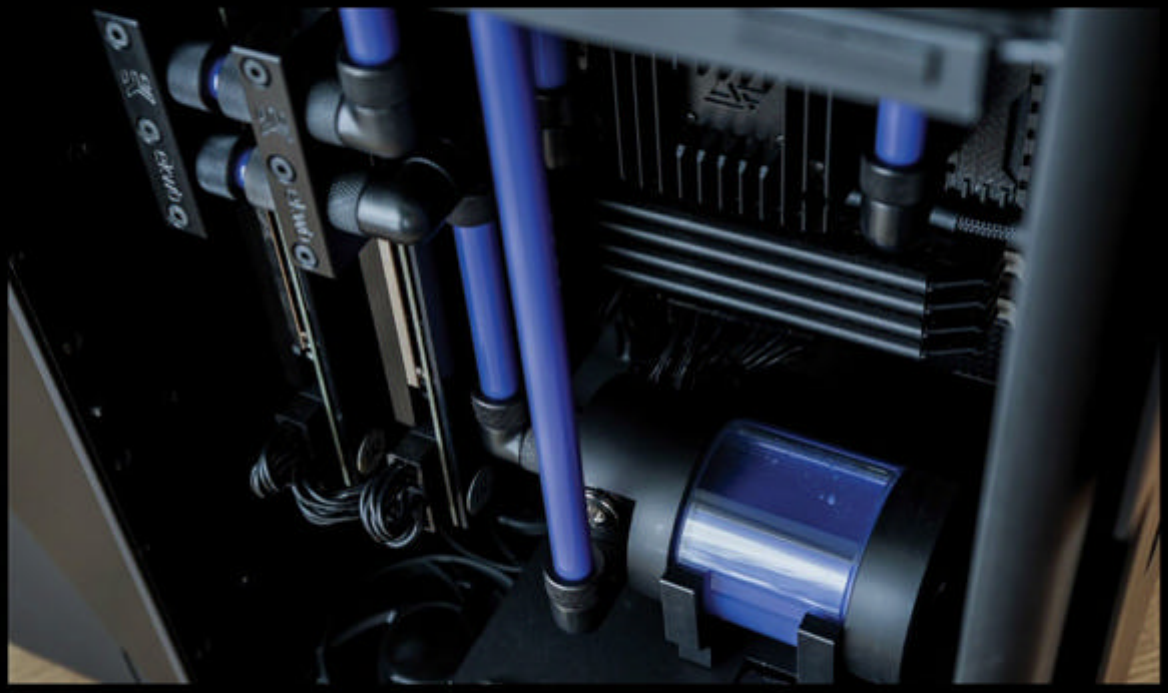
Memory 16GB (4 x 4GB) Corsair Vengeance Pro 2,133MHz

Motherboard Asus Gryphon Z87 + Armor kit

Storage Samsung 830 Pro 512GB SSD

PSU SilverStone ST85F-P 850W

Cooling Phobya Xtreme 400 radiator, 2 x Phobya G-18 180mm fans, Swiftech Apogee Drive II CPU/pump combo, 2 x 80mm Be Quiet! SilentWings PWM 2, EK-RES X3 110 reservoir, 2 x EK-FC780 GTX Ti (Acetal + Nickel), 2 x EK-FC780 GTX Ti Backplate (Black), EK fittings



chassis if they peeked through my kitchen window.

CPC: What materials did you use?
Justin: I used aluminium and acrylic glass. All the panels were made from recycled aluminium from my work. We have a photo production room where I work, and there are often aluminium off-cuts there, which I'm more than welcome to pick up for myself. The aluminium used was 2.5mm thick. I used an aluminium U-profile, which was 4mm thick for the radiator brackets.

The main front panel is one piece of aluminium that's almost 1m long, with a single 90-degree bend. This panel is in place for two reasons – firstly, to give a menacing and sinister look to the chassis, and secondly, to cover the power and reset buttons so that my daughter couldn't shut off the PC by accident. She's almost two years old, and enjoys testing her limits! The 2mm acrylic glass is used on the side panels, and attached using double-sided tape. I'd considered using smoked acrylic, and still might make the change if I upgrade this build in future.

CPC: What tools and machinery did you use?
Justin: Before this project I'd worked exclusively with hand tools. As I was short on time with this project, though, I had the panels milled by a local company that specialises in custom one-off projects.

This process required for me to use a PC to create the model so that it could be milled, and to learn how to use a CAD program. I also used a regular hand drill with step drill bit, a Dremel, a good set of diverse files and a machine ruler.

CPC: How long did the build process take?
Justin: Just two months from the start of planning to the finished build. Routing the water-cooling parts took the longest time, as I wanted to measure up the holes perfectly so that the tubing ran straight. These holes couldn't be measured and CNC-milled, so I measured and drilled them by hand.

CPC: What have you learned from the build process?
Justin: During the building process, I've learned that using a CNC saves time, but at the cost of that 'personal touch', which I've always liked. I've also learned that it's optimal to position the reservoir above the pump, but it isn't entirely necessary if you're willing to dance and shake it with the build.

CPC: Are you happy with the end result?
Justin: I love Monolith; I wouldn't change a thing about it! CPC

BE A WINNER

To enter your machine for possible inclusion in Readers' Drives, your mod needs to be fully working and, ideally, finished based in the UK. Simply log on to **www.bit-tech.net** and head over to the forums. Once you're there, post a write-up of your mod, along with some pics, in the Project Logs forum. Make sure you read the relevant rules and advice sticky threads before you post. The best entrant each month will be featured here, where we'll print your photos of your project and also interview you about the build process. Fame isn't the only prize; you'll also get your hands on a fabulous selection of prizes – see the opposite page for details.

Win all these prizes!

We've teamed up with some of the world's leading PC manufacturers and retailers to offer this great range of prizes to each lucky Readers' Drives winner. If your creation is featured in the magazine then you'll walk away with all of the prizes listed on this page, so get in your entries!

Corsair graphite Series 230T case and RM 550w Modular power supply

TOTAL VALUE £150 inc VAT / **MANUFACTURER** www.corsair.com

Corsair believes that a great PC starts with a great case. The Corsair Graphite Series 230T is a compact expression of this core philosophy. With stylish looks and a choice of three different colours, it packs in a remarkable number of features to provide builders with tonnes of room for expansion and amazing cooling potential. Like all Corsair cases, it's built using the finest materials and finished to the highest standards, so it will withstand several years of upgrades. Plus, to make sure it stand outs from the crowd, the 230T features Corsair's new Air Series LED high-airflow fans, providing distinctive lighting with low-noise, high-airflow cooling.

Just as a quality case is essential to building a quality PC, a high-performance, a high-quality power supply is also a vital ingredient. The all new RM series has been built from the ground-up to deliver unmatched reliability alongside 80Plus Gold efficiency, and all with the absolute minimum of noise. It uses specially optimised quality parts to reduce sound at the component level, and it's completely silent below 40 per cent load, thanks to its Zero RPM fan mode. It's also fully modular, allowing for the maximum amount of flexibility during installation. With a Corsair Graphite 230T case and an RM 550W Modular power supply at the heart of your build, you'll have the foundations for a truly awesome gaming machine.

Mayhems coolant and dyes

VALUE £50 inc VAT / **MANUFACTURER** www.mayhems.co.uk

Cooling performance is only one part of the equation when it comes to kitting out your rig with custom water-cooling gear. The other major bonus is that all those tubes and gleaming fittings just make your PC look damn sexy, and they look even better when they're pumped full of fancy coloured coolant. As such, we're particularly pleased to have the folks at Mayhems now on board with Readers' Drives; they're currently offering two 1-litre bottles of Mayhems' Pastel Ice White coolant, along with a selection of five dyes, so you can choose the colour that best complements your PC. Check out the blue coolant in our own mini PC mod on the cover of Issue 109 for an example of what's possible with some Mayhems coloured coolant.

Phobya Modding Kit

VALUE £50 inc VAT **MANUFACTURER** www.phobya.com, www.aqua-tuning.co.uk

The Phobya modding kit is designed with the modder in mind, offering great value for money and quality products. The kit includes Nano-G 12 Silent Waterproof 1,500rpm multi-option fans, which use an innovative fan-blade design. As standard, the fans include braided black cables to keep your case looking as neat as possible. The fans are also supplied with a special cable that lets you run the fan at 5V rather than 12V, reducing the noise emitted in order to help you to build a silent system.

The kit also includes the 60cm Phobya 3-pin Molex to 4x 3-pin Molex Y-cable. This pre-braided extension cable gives you extra routeing options in your case, and it also enables you to run up to four fans from one compatible motherboard header. Meanwhile, the Phobya SATA 3 cables included in the kit offer the same great quality braiding as the rest of the Phobya range, while also securing your connection with latched connectors. As well as this, the kit includes the Phobya SlimGuide Controller, which gives you the option to vary the speed of other fans in your case, while the Phobya TwinLEDs let you shine a light on your mods.

Folding@Home

Join our folding team and help medical research

Folder of the month / We catch up with: GreenDemon360

CPC: So who is GreenDemon360?
GreenDemon360: My name is Richard Frith, and I'm an IT support technician for a manufacturing company. I've been in IT for 30 years, specialising in Microsoft products and technologies. I'm a family man, and I play Titan Fall when I get time.

CPC: Why did you start folding?
GreenDemon360: I built my new rig last year to get back into gaming after a long break. I soon realised that this powerful box wasn't doing much apart from a couple of hours in the evening playing Titan Fall. When I read through **Custom PC** for guidance with my new build, I learned about folding, and it was clear there was no better way to utilise that spare power than by helping out with medical research. It's great to know that, somehow, my contribution is making a difference.

CPC: How many PCs do you have folding?
GreenDemon360: My main gaming rig is the primary folder. I've tried

running the software on my work laptop in lunch breaks, and firing up some of my older machines at home, but those low-spec machines just don't cut it unfortunately.

My main gaming rig is a Core i7-4770K with 16GB of RAM and an R9 270X. I have all-in-one liquid coolers on both the CPU and GPU, so I can push them without worrying about frying them. My gaming rig runs 24/7 in the conservatory. I mainly use Windows 8.1, but I also have a Linux Server in my house running 24/7, and I'm looking to see if I can upgrade its hardware later this year, so hopefully I'll have another machine contributing soon.

CPC: What's your best folding kit?
GreenDemon360: The overclocked i7 is doing a great job, but the R9 270X is also really impressive for a mid-range graphics card.

CPC: Do you intend to keep up your current production level?
GreenDemon360: I see no reason why not; I'm happy leaving my gaming rig running 24/7, but my production will only improve if I upgrade some of the components.

CPC: Any tips for fellow team members?
GreenDemon360: Don't worry too much about leaving your machine on 24/7. Since I started doing it, my electricity bill hasn't really changed much. Modern kit is very power-efficient nowadays.

CPC: What do your friends and family think about your folding?
GreenDemon360: Everyone I've spoken to thinks it's an amazing idea. We have a dementia sufferer in our family, so medical research is close to our hearts.

CPC: Is there anything you'd change about your folding setup?
GreenDemon360: It has to be a GPU upgrade next – maybe a Radeon R9 290, or an additional 270X, as they offer great value for money.

STATS

Team rank 257
World rank 12,667
Score 4,802,715
Work units 683
Daily points average 40,593

TOP FOLDERS: This month's shout-outs go to HHComputers, Slavcho, Semmy and BeezaBob. If you fold under any of these names, email **folding@custompcmag.org.uk**

WHAT IS FOLDING?

Folding@home uses the spare processing cycles from your PC's CPU and graphics cards for medical research. You can download the client from **http://folding.stanford.edu** and our team's ID is 35947. Once you pass a significant milestone, you'll get your name in the mag. You can also discuss folding with us and other readers on the **www.bit-tech.net** forums.

MILESTONES THIS MONTH

USERNAME	POINTS MILESTONE
Andy_J	20000
bradbooth	20000
Alee4177	30000
pig_farmer_uk	30000
LynnRFlye	40000
Just_G	50000
Unstoppable	50000
Ch1nb34rd	70000
dave	70000
NoiseBoySSL	70000
NitroCruze	80000
purerizzo	100000
reidmarc	100000
Chrisz0rz	200000
Ganey	200000
Lethaertes	200000
mar_duke	200000
ViperB5	200000
LSB86	300000
Quozzbat	300000
TheRepublic ofKirkup	300000
andboo1	400000
HolyCow	400000
The_FFrey	400000

USERNAME	POINTS MILESTONE
Hateboy	500000
lilmatt157	500000
BondyBoy	600000
carbontwelve	600000
daza17	700000
ligmon	700000
Aedin	800000
andboo1	800000
robertmather	800000
siddallj	800000
ssjandu	800000
varnis	800000
KJGouldstone	900000
robgsxrk4	900000
stevec83	900000
BaskB	1000000
bbnsol	1000000
StuManchu	1000000
BobN	2000000
kornvdd	2000000
marcusclegg	2000000
PaddyandStuff	2000000
Brentwood-Computers.com	3000000
Flowwwie	3000000

USERNAME	POINTS MILESTONE
Liam266	3000000
meandmymouth	3000000
Bluce_Ree	4000000
GreenDemon360	4000000
madmatt1980	4000000
Taffers1966	4000000
Bedders	5000000
crazystuntman	5000000
gupsterg	5000000
Mem	5000000
Reiep	5000000
Dave_Laffin	6000000
Humwawa	6000000
Semmy	6000000
toothytech	6000000
Grimpeeper	7000000

USERNAME	POINTS MILESTONE
Jon_Simmo	7000000
Portchylad	7000000
rvalkass	8000000
Dickie	9000000
SgtDunk	9000000
Little_Willie	10000000
HHComputers	30000000
luckybfocus	30000000
Cmaxx	40000000
Roveel	40000000
TrilithiumInjector	40000000
apeman556	60000000
Desertbaker	90000000
Laguna2012	100000000
Slavcho	200000000

THE NEXT OVERTAKE

WORLD RANK	TEAM NAME	POINTS	DAILY POINTS AVERAGE	TIME UNTIL OVERTAKE
7	TSC! Russia	15,238,545,716	16,674,675	7.2 months
8	Custom PC & bit-tech	14,412,671,351	20,478,245	0

TOP 20 OVERALL

RANK	USERNAME	POINTS	WORK UNITS
1	Nelio	2,249,991,920	98,688
2	DocJonz	944,516,642	169,455
3	coolamasta	661,582,113	155,992
4	Scorpuk	482,663,272	12,959
5	Dave_Goodchild	455,408,105	117,155
6	StreetSam	450,692,840	87,095
7	piers_newbold	348,727,810	34,774
8	johnim	270,090,578	77,999
9	phoenicis	250,044,587	95,660
10	PC_Rich	228,298,817	69,275
11	Slavcho	214,987,559	31,268
12	Wallace	212,477,027	6,204
13	zz9pzza	211,014,628	15,794
14	Lordsoth	190,905,000	88,733
15	The_M2B	183,941,335	52,859
16	Ben_Lamb	166,053,146	2,891
17	Christopher_N._Lewis	152,375,847	35,858
18	TheFlipside	133,607,265	18,669
19	Lizard	131,878,662	60,132
20	fir3x	125,247,764	20,081

TOP 20 PRODUCERS

RANK	USERNAME	DAILY POINTS AVERAGE	OVERALL SCORE
1	Nelio	5,222,739	2,249,984,645
2	DocJonz	1,348,006	944,313,377
3	StreetSam	1,240,061	450,589,886
4	HHComputers	1,195,935	36,298,473
5	Scorpuk	1,014,977	482,631,192
6	johnim	681,058	269,997,353
7	Slavcho	658,014	214,889,777
8	piers_newbold	645,162	348,676,015
9	PC_Rich	579,097	228,241,235
10	TheFlipside	574,622	133,569,177
11	coolamasta	553,191	661,503,127
12	Laguna2012	501,023	103,167,966
13	The_M2B	452,903	183,885,715
14	Lordsoth	452,650	190,851,045
15	Desertbaker	389,446	98,649,529
16	apeman556	302,137	67,635,263
17	Oatyflapjack	266,773	19,618,009
18	TrilithiumInjector	261,961	41,987,646
19	Roveel	246,686	40,739,656
20	KevinWright	212,897	122,363,647

JAMES GORBOLD / HARDWARE ACCELERATED

HOW DO WE FUND GAME DEVELOPMENT?

James Gorbold asks if the unrealistic expectations of crowdfunded PC space sims is putting the model at risk

Over the past few months I've developed a fear that crowdfunding as a model for paying for game development may be about to come crashing down around us. I'm a big fan of the concept of crowdfunding, as it puts creative types, such as game developers, musicians and artists, directly in touch with their customers. It cuts out the production studio middle men who, by their nature, tend to make decisions in a very conservative manner.

For PC enthusiasts, a great example is the space sim, which pretty much died as a genre in the late 1990s, but has recently been resurrected by several notable crowdfunding campaigns, resulting in two new games, Elite Dangerous and Star Citizen. Of the two games, only Elite Dangerous has been released, but it's already run into considerable controversy, as the developer removed the ability to play offline without a connection to its servers just a week before release.

> The problem with Elite Dangerous is that it's boring, and would be better renamed Elite Drab

However, the far more serious problem with Elite Dangerous is that, despite what **Custom PC**'s games editor thinks, it's fundamentally boring, and would probably be better renamed Elite Drab. While dogfighting in Elite Drab can be fun, it's such a rare occurrence among the mind-numbing slogging across the bland, procedurally generated universe, and the endless opening and closing of silly little menus, that the payoff in terms of fun simply isn't worth your while. I'm not arguing against complexity here. After all, I really enjoy flight simulators, not to mention real-life flying, but Elite Drab gets the balance between fun and tasks completely wrong.

I'm even more fearful for Star Citizen, because I think it's going to be victim of its own incredibly successful funding campaign. As I type this column, Star Citizen has raised a staggering $73.6m towards its development, dwarfing the funds of other crowdfunded games, which only in rare cases have raised more than a couple of million dollars.

Star Citizen still continues to raise money at a healthy rate of $40,000 a day, resulting in ludicrously high expectations and feature sprint, which is what I call feature creep when it's gone into overdrive. While I'd like to think that Chris Roberts and the other highly experienced developers working on Star Citizen may still be able to rein in the beast, and deliver a great space sim, there seems to be more focus on making oversaturated demos and videos than delivering a solid, fun space sim.

However, my real fear is that the bar has been set so high for Star Citizen that it's bound to end up being disappointing. It's raised so much more money than any other crowdfunded gaming project, and it will be hard to deliver on the expected quality.

Assuming that Star Citizen doesn't live up to expectations, the end result will be a backlash that destroys all confidence in crowdfunding as a business model. This situation would be tragic, as crowdfunding has already resulted in several amazing projects, such as the Oculus Rift, Shadowrun Returns and Wasteland 2, with many more in the works, such as Underworld Ascendant. I'm still hoping that I'm being unrealistically pessimistic here, but I have a nasty suspicion that the PC space sim may be in for an even bigger crash than its plummet in the late 1990s. CPC

James Gorbold has been building, tweaking and overclocking PCs ever since the 1980s. He now helps Scan Computers to develop new systems.

DinoPC.com

Griffin 15.6" 840M

- Intel® Core™ i3 4100M processor (2x2.5Ghz)
- Windows 8.1 (64-bit)
- 8GB DDR3 1600Mhz RAM
- NVIDIA GeForce 840M 2GB
- 8x DVDRW
- 500GB S-ATAIII HDD
- 15.6" HD 1366x768 LED
- 2.0M Webcam + Card Reader
- Wifi + Bluetooth

£549 inc VAT

Elegant and slim laptop with superb all-round performance

The Winning Species

Trust us to build you a champion's PC for less.

Slayer 15.6" £1,099

- Intel® Core™ i7 4710MQ processor (4x2.5Ghz)
- Windows 8.1 (64-bit)
- Corsair 8GB Vengeance 1600Mhz RAM
- 256GB SSD
- NVIDIA GeForce GTX 870M 6GB
- Wifi + Bluetooth
- 15.6" Matte LED (1920x1080)
- 2.0M Webcam + Card Reader

"Bettery life is good...And there is plenty of horsepower under the hood"

Infernodon 4790K £1,429

- Intel® Core™ i7 4790K processor (4x4.5Ghz)
- Corsair Hydro H100i Water Cooling
- Windows 8.1 (64-bit)
- Gigabyte Z97X-Gaming 3 Motherboard
- Corsair 16GB Vengeance Pro 2400Mhz RAM
- NVIDIA GeForce GTX 980 4GB
- Plextor 128GB M.2
- Seagate 1TB Hybrid SSHD
- NZXT H440 Chassis
- Corsair CS 650W Modular PSU

"This superb Devil's Canyon machine won't dissapoint"

Microraptor 4690K £1,039

- Intel® Core™ i5 4690K processor (4x4.3Ghz)
- Windows 8.1 (64-bit)
- Gigabyte Z97N-Wifi Motherboard
- Corsair 16GB Vengeance 1600Mhz RAM
- 128GB SSD
- 1TB S-ATAIII 6.0Gb/s HDD
- NVIDIA GeForce GTX 970 4GB
- Coolermaster Elite 130 Chassis
- Corsair CX 600W PSU

GIGABYTE™

PC ADVISOR ★★★★★

"A gaming PC that delivers excellent performance for the price"

Discount Code:
CPC6GB3W

Free 16GB flash +
3 working day priority

DinoPC.com

www.dinopc.com
0844 999 4123
Or visit our London office

www.scan.co.uk

t: 01204 47 47 47

SCAN COMPUTERS

Our service is tested...

But never questioned.

CUSTOMPC AWARDS 2014 Best PC Manufacturer · CUSTOMPC AWARDS 2014 Highly Commended Retailer · CUSTOMPC AWARDS 2014 Editor's Choice Best Desktop PC · expert REVIEWS · HEXUS PERFORMANCE · PC PRO Excellence Awards 2014 · 3DArtist · DEVELOP3D · PCFormat Gold · CUSTOMPC EXTREME · CUSTOMPC PREMIUM

Scan Platinum Partners

SHIELD™ TABLET

NVIDIA SHIELD. BUILT FOR GAMERS.

Take on thousands of the best Android games with stunning graphics and smooth gameplay including titles optimized for the NVIDIA® Tegra® processor and controller support. You can even run the most popular game emulators available on Google Play ™ to relive your retro gaming days.

CORSAIR — Low Noise. High Performance. Carbide Series® 330R Titanium Edition

The Carbide® Series 330R Titanium Edition starts with the award-winning original 330R, and adds a brushed aluminum front panel with a three-speed fan controller.

intel® Core™ i7 Processor Extreme Edition

Want maximum performance in your favourite content creation applications and games? Then the new Intel Core i7 processors, based on the Haswell architecture, were made for you. This new range of LGA2011 socket processors feature more cores, more cache and more memory bandwidth than ever before, delivering the ultimate PC experience.

Don't buy hardware without Scansure protection. 28 day installation damage insurance www.scan.co.uk/scansure.

SF Scan Finance. Buy now, pay 10% deposit* and spread the cost over 36 or 48 months when you spend £300 (inc vat) or more.

Prices correct at time of print. Classic credit options (36 or 48 months). Customers will initially only have to pay a 10% deposit, with the orginal loan amount payable over 36 or 48 months.
*Example: £1,000.00 Deposit: £100.00 Amount of loan: £900.00 Total charge for credit:£276.12 Total payable:£1276.12 Total 36 Monthly instalments of:£32.67 APR:19.9%. Terms and Conditions Apply.